A Plantation of Eucalyptus Globulus at Ootacamund.

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AN INDIAN BUREAU OF FORESTRY.

Cuilibet in sua arte perito credendum est.

1. GENERAL REMARKS.

IT has long been recognised by European Foresters that there is a large amount of special professional and scientific work to be carried out in connection with the proper care of the forests, and that this work cannot be performed by the officers engaged in ordinary executive duty; this latter if it is to be done efficiently necessarily requiring all the time and energy at their disposal. In order to ensure that this special professional and scientific work shall be effectively undertaken a special branch exists in the forest services of the various European States, and such a one has been recently created in America. To this branch the name of Bureau of Forestry is usually applied, and the several specialists appointed for the work are accredited to it. The officers of this Bureau concern themselves with the operations in connection with the supervision, etc., of working plans; with special investigations into (1) the reservation of any fresh areas required for climatic reasons and the preservation of the water supply; the requirements of districts as yet containing no forest reserves, or regulated district or village forests; with enquiries as to the best commercial trees to be found in the forests in different parts of the country, and as to the possibility of creating a demand for and putting on the market species for which there has been up to date no sale; with general forest botany, the distribution of the various species, etc.; the various diseases, insect and fungus, from which the forests suffer; and, lastly, with the very important investigations into the possibilities of the various minor products of the forests from a revenue point of view.

We will consider shortly these various forms of enquiry and research together with their bearing and importance on the management of, and on the revenue to be derived from, the forest estate.

(*a*).—*The preparation and supervision of working plans.*—

i. *Sylviculture.*—The Working Plans Branch would make the study of sylviculture a special part of their work. During their tours the officers would make careful observations and notes on this subject in collaboration with the local Divisional Officers. The elaboration and publication of such notes would be of the very greatest utility to the local officers, since the department would soon have some useful and adequate data on the sylvicultural requirements of our various species, a subject upon which at present, we think that most officers will agree available data are almost as absent as they were in the time of our predecessors, the forest pioneers of thirty years ago.

ii. *Working Plans proper.*—The supervision of existing working plans, enquiries into necessary deviations from such, checking draft plans, the preparation of notes for new plans, etc., would form the main part of the work of the Working Plans staff.

(*b*).—*Reports on afforested lands still not under reservation.*—Such areas would be carefully inspected and the requirements of the surrounding inhabitants and the extent of their dependence on local forests not under the management of the department would be fully considered. It is well known that such forests are rapidly disappearing, and that if left without proper supervision they will soon cease to exist. There are still such in districts never visited by a Forest Officer, and which, consequently, never fall within his province to report upon.

(*c*).—*A systematic record of all boundary work.*—This would be carefully drawn up and kept on record in the Bureau, where it would be readily available for easy reference.

(*d*).—*Measurements of rates of growth of the various species.*—A large series of Sample Plots of all the most important species would be established all over the country. All records of the

measurements made annually (or more often if considered necessary) would be kept in the Bureau. Two important objects would be gained thereby. The first that the measurements would be continuous and would be unaffected by the unavoidably constant changes in the *personnel* of the staff of the various divisions in which the plots existed, and secondly (and more important still) the available data would be all collected in one spot, thus enabling statistics to be compiled and issued for general information as their value and usefulness became apparent.

(*e*).—*Advice and preparation of simple working plans for private owners.*—This would be undertaken by the officers of the Bureau in all cases where it was apparent that it was of advantage to the State that such lands should be kept under forest. This question is of the first importance in mountainous regions and in hilly areas where the safety of the agricultural lands depends upon the hills being kept under forests.

(*f*).—*Grazing and fire-protection.*—The innumerable questions arising in connection with these important subjects would also engage the attention of the Working Plans staff.

III. GENERAL INVESTIGATIONS.

These can be divided into several very important sub-divisions

THE MAPPING OF TRACTS TO SHOW THE DISTRIBUTION OF THE MORE IMPORTANT TREES IN THE COUNTRY.

(1) Studies of various classes or kinds of forests in India with a view to the preparation of accurate maps of each tract showing the distribution of such forests in the country and the areas they occupy. Pamphlets with a map in each would be drawn up for circles and divisions.

COMMERCIAL TREES.

(2) The systematic study of the more abundant trees in India with a view to the introduction, either to local or home markets, of species at present not used. In this connection the more ornamental woods of the country should be carefully studied. Experiments on a commercial basis, *i.e.*, such as would satisfy

commercial requirements, would be made with the woods with the object of placing them upon the market in such a manner as to ensure their meeting with success.

FOREST BOTANY.

(3) The distribution of the commercial trees would be accurately ascertained; the portions of the country where they grow best or are in greatest abundance be found out, and their area definitely laid down on a map. A short monograph on each tree would be drawn up as soon as all possible information about it had been collected. In this the areas in which its growth is at present the best should be given as also those in which, from the evidence of old stumps, it is made evident that in former days its growth was exceptionally good. A list of associated trees should be always given at the end of the monograph. Each tree would be dealt with by itself, and at the end of the pamphlet a small map would be attached showing the distribution (*a*) as pure forest, (*b*) mixed forest.

FOREST ENTOMOLOGY.

The great importance of the thorough study of the life-histories of injurious insects has been recognised, and a special officer has been already appointed to deal with this branch.

MINOR PRODUCTS.

It will not, we think, be contended that one tithe of the minor products of the Indian forests are known from an economic point of view. That there are great possibilities in this direction is the opinion of those who have considered this question. It has become apparent, however, that little progress is possible until the department are enabled to take up the matter themselves. A special officer attached to the proposed Bureau would be in a position eminently favourable for dealing with this large and important (from a revenue-making point of view) subject.

WOOD AND BARK.

(4) *Tannings.*—Especial attention is required to be paid to the investigation of tannings with a view to placing them upon the

market. A question of this nature requires the specialist, the man who could devote his whole time to this and cognate subjects. The chemist would analyse all important products.

Wood pulps also require much attention. The forests of the country contain large amounts of at present unutilizable timber of inferior quality. It has proved impossible for a Divisional Officer to dispose of them, and yet he is aware that they would in all probability do very well for wood pulp, and would supply the whole of the coarser paper required in the country.

TREE-TAPPING.

Rubber—Turpentine.—Whilst the actual growing and tapping of plantations as, *e.g.*, of rubber and of *P. longifolia*, etc., is the work of the Executive Officer, it would fall to the minor products specialist to find out about the best markets and the localities in which a certain produce is in most demand, etc. For instance, it is common knowledge that the difference in the prices of rubber is very great, varying with the species and the quality of the product obtained, both of which must depend to a great extent upon the nature of the soil, aspect, climate, elevation, etc. A specialist should be able to advise a local officer who was intending to put out rubber plantations on all these points. Again, competition amongst respective circles and divisions is undesirable. We believe that the industry in connection with the tapping of *P. longifolia* for turpentine was started in the School Circle and subsequently taken up in the Punjab, with the result that the latter Circle was able to cut out the former by underselling it. It would be the duty of the Bureau to see that this sort of thing did not occur, and that one part of a province did not expend money on undertaking a supply which could be done much more remuneratively in another.

OTHER MINOR PRODUCTS.

(5) *Myrabolans, grasses, canes, bamboos, gums.*—There can be little doubt that merchants at present suffer from not knowing what the forests contain and where articles can be obtained. Also, the commercial minor products of the country are by no means worked

up. We understand that in this connection Burma has now put on a special officer to deal with the subject. This is distinctly a step in the right direction.

A specialist of the Bureau would make this commercial aspect of the case his business. He would be acquainted with all the great firms, would know what things were in demand, whether others were likely to have a sale if placed on the market, would endeavour to create markets for new products by putting them on in such a condition that enterprising traders would soon come forward *to take them up.*

FORMATION OF PLANTATIONS.

(6) With the knowledge accumulated by the Botanical and Commercial Wood Specialist it would be possible for him to advise on the formation of valuable plantations in the country. A good commercial as well as sylvicultural knowledge of the value of the trees and whether a demand is likely to be maintained for their products is necessary before Government can be asked to make large outlays on plantations. An accurate knowledge of the means of communication in the country, the likelihood of feeder lines being built, mines opened (for which timber would be required), etc., etc., is necessary. Such knowledge, whilst being more or less of a sealed book to the local Divisional Officer, would be easily acquired by the specialist during his constant tours.

PUBLICATION OF RESULTS OBTAINED.

It is suggested that the best way of making immediately available to the department the results of the investigations of the Bureau would be to publish yearly Proceedings in which the information obtained by the various officers of the staff during the year would be collected together and issued. This would not preclude the same notes or information appearing again when sufficient data had been accumulated for the publication of a monograph on any *particular* forest tree or minor product. This is the procedure followed for some years by the Geological Survey, and which has now again, we understand, been revived under the present capable head of that department.

It may be said that this work would overlap with the Botanical Survey on the one hand and the Reporter on Economic Products on the other hand. We think not. We are of opinion that the Director of the Botanical Survey would be only too glad to have the sustained active co-operation of the department in this way. In the case of the Reporter on Economic Products, there can be little doubt that the Forest Officer with his special training and personal knowledge of the forests is perhaps the most efficient person to find out what are and what are not the most likely products to exploit, and the knowledge would be more quickly published and come at first hand if advertised by the Forest Specialist. In addition it would enable the heavily worked Reporter to devote all his energies to the agricultural staples of the country.

On the subject of acquiring the various specialists it may be pointed out that, since the department is officered by men who have received a sound scientific training, it may be taken for granted that from their numbers it will be possible to lay hands upon the requisite specialists.

THE STAFF.

A few words may be said on the subject of the staff required.

Working Plans.—We are of opinion that the Bureau, to be started upon good sound lines, would require two Working Plans officers. As already detailed, these men, whilst undertaking the work now performed by that over-worked individual the Assistant Inspector-General of Forests, would also tour round the country and make themselves practically acquainted with the method of working of each plan, would be in a position to decide upon questions of deviations from plans, would deal, under the Inspector-General, with the supervision of the preparation of new plans, would devote time to the study of sylviculture, etc.

Forest Botany.—The specialist would be required in connection with the investigation of commercial trees with a view to placing them upon the market. He would also make a special study of, and advise local officers upon, the question of the formation of plantations, and would draw up the pamphlets on the various

classes of forests in the country. He would also be in charge of Forest Botany, with all the branches above described.

Forest Entomology.—This appointment already exists, and a distinct advance has been made in this important branch.

Minor products.—The work upon which this officer would be engaged has already been fully detailed. He would be required to have some knowledge of Chemistry.

One of the staff would be placed in charge of the editorial work in connection with the publication of the yearly "Proceedings."

The question as to whether it might be necessary to set aside for the Bureau small areas of forest in various parts of the country for experimental purposes is a matter which need not be entered into here.

This question of the formation of a Forest Bureau is one which we have often heard debated amongst Forest Officers, but we have never heard a reference made to the strong parallel which exists between the Geological Survey and the Forest Department in this matter. Both have their "crops" to deal with—the one mineral, the other vegetable. The Geological Officers have to search for and find their crop, which is hidden in the bowels of the earth or strewn in unrecognisable or unmarked forms on the surface. For such work a Bureau of Specialists is required, and exists. Having discovered the "crop" the rest is left to private enterprise, and thus a large executive staff is not required. In addition, however, to this purely economic and commercial part of their duties, the scientific work performed annually by the Survey is of immense value. If now we consider the case of the Forest Department we see that the crop either exists on the surface or has to be created; but since it is an ever-changing one, being subject to constant additions and removals a large executive staff is necessary for its present management and to ensure its continuance for future generations. This work more than fully occupies the whole of the time and energy of the present staff. The study of the sylviculture of the trees, enquiries into their commercial value, investigations into minor products, and that purely scientific work which reflects a lustre alike on a department and upon its

Government, all these have had in the past to be neglected. It is to undertake the important researches of this nature that we venture to suggest that the Forest Department should be placed in a position similar to that of the Geological Survey and that an Indian Bureau of Forestry should be formed.

SCIENTIFIC PAPERS.

THE CASUARINA BARK-EATING CATERPILLAR.

(ARBELA TETRAONIS, MOORE.)

BY C. E. C. FISCHER.

Those who have been favoured with a copy of Mr. Stebbing's Note on Casuarina Insect Pests* will recollect that the first insect dealt with bears the name that heads these lines.

Mr. Stebbing summarized the information then known, suggested protective measures, and stated six points on which further information was desirable.

It was in the Government plantation (the Agusti Nowgam reserved forest) near here that Mr. Stebbing studied the insect during a brief visit in July 1903; and as I have since then had the insect in that plantation under as close an observation as circumstances permitted and have had the experience of one year's attempted protection, I have drawn up the following note in the hopes that the conclusions come to will be of service.

It will not be amiss to preface a short description of the plantation itself. The Agusti Nowgam plantation was started in 1893. Its primary object was the protection of the fields of the village of the same name from the encroachment of drifting sand. The village to be protected is on the shore of the Bay of Bengal on the southern bank of the Rushikulya river, the chief water-

* "A Note on the Casuarina Insect Pests of Madras," by E. P. Stebbing, F.L.S., F.E.S., Officiating Superintendent, Indian Museum, Calcutta: Office of the Superintendent of Government Printing, India, 1903.

course of the Ganjam district. Violent south-east winds carry the sand along to an almost incredible extent. (It is only by great and constant labour that the public buildings and offices of the adjacent small port of Gopalpur are kept free of the all-pervading sand.) Where any obstruction to the free drift of sand is met, the latter is piled up in dunes 50 feet and more in height, and the windward rows of Casuarinas are completely buried. In its protective mission the plantation has been entirely successful. The area of the reserve is 700 acres, but so far only 329 acres have been actually planted up. The area planted is V shaped; the threatened fields are in the angle, and the apex is presented to the south-east wind. The plantation has met with very varying success; in most places the result is highly satisfactory, but here and there patches have quite failed to produce useful trees. Not a little of the failure is due to water-logging in low-lying places, but by far the most important factor will probably prove to be a noxious fungoid disease, which is now under investigation. The maximum growth for ten years produced poles 75′ high with a breast-height girth of 40″.

The plantation is about 3½ miles from Chatrapur, the chief market supplied. Owing to the sandy nature of the ground to be traversed, transport charges are rather heavy. Fortunately the presence of a considerable lake facilitates transport over some two miles of the distance. The quantity of wood annually exploitable is too small to warrant the laying of a trolly line, and the small demand, shared by two or three private plantations, precludes the planting up of a larger area for the present. A regular working plan was framed and sanctioned in 1903, but, as will be seen, had to be deviated from at the start. The plan provides for clear felling and uprooting over 32 acres every year (9 acres are reserved as a break-wind belt on the outside edge of the two legs of the V, leaving 320 acres to be felled over in ten years). The area felled is to be replanted during the ensuing rains. Originally the seedlings were put out 6′ × 6′, but the plan provides for replanting 9′ × 9′, which is cheaper and gives better results.

To return to the insect pest. Its appearance in the plantation was first observed and pointed out to me by the Conservator of the Circle in December 1902. This was my first acquaintance with it, but the Conservator had seen it and its depredations elsewhere, and warned me accordingly.

The progress of the attack was closely watched, and specimens of the larva were sent to Mr. Stebbing. The attack on this occasion was not a severe one, and the insect appears to have first made an entry into the plantation in the month of September. The imago issued the following June and July; the new generation was then watched for, and was first observed early in September. It soon became very obvious that this fresh attack was far more intense than that of the previous year and had spread centrifugally from the site of the original attack.

Immediately curative measures were started, as suggested by Mr. Stebbing, and boys were sent round to collect and kill the larva under the charge of a watcher.

Almost from the beginning the impossibility of destroying all the larvæ became evident, as the flexibility of the topmost branches, upon which their presence was visible, prevented their being climbed. The destruction was, however, persisted in for a time in the hopes of making a considerable impression on the invading hordes. Meanwhile the two watchers were marking with whitewash all trees on which the destructive covered ways of the larva could be seen.

When early in October, after the destruction of over 63,000 larvæ no appreciable diminution in numbers had been effected the urgency for more drastic measures became apparent. Sanction was obtained to depart from the provisions of the working plan by abandoning the felling of the year's coupe and cutting out all infected trees wherever found throughout the plantation. In addition the neighbourhood of the lake referred to above was taken advantage of, the felled poles being transported thither as soon as possible and immersed for several days. Unfortunately, owing to the heavy sand and the scarcity of labour just then, transport could not keep pace with felling, and the poles had to

be left lying in the plantation for some time. It is therefore possible that some of the larvæ migrated from felled to unfelled trees. There is, however, no evidence in support of this presumption, and as the larvæ are very reluctant to leave their retreats and covered ways this change of abode must not be accepted as certain. In all about 25,000 trees were felled. The result of this operation was awaited with some impatience. High hopes were entertained that the pest would be eradicated—hopes unfulfilled however.

At the end of August of this year (1904) the first covered ways of the new generation were observed. At first this was put down to a few trees attacked last year being overlooked, but this was soon seen not to account for the entire fresh outbreak.

Just outside the plantation, the villagers have themselves planted up about an acre with Casuarina. This patch was attacked by the Arbela last year, and being somewhat concealed behind a hitherto uninfested portion of the reserve, was most unfortunately overlooked. The new attack is not of a very severe nature and is more restricted in its spread, so that the measures adopted last year were at least partially successful. It is hoped that a further operation including in its scope the small private patch will rid the plantation of the pest for some time at least.

The following observations on the insect and its habits, as they bear directly on protective methods, will, I hope, prove useful.

As Mr. Stebbing, in the Note already quoted, has described the Arbela in all its stages (excepting the ♂ imago not then seen by him), it will only be necessary to mention that the ♂ insect is similar to the ♀ but about half the size.

Life-history.—The moth issues during June. In 1903 a ♀ from a captive pupa issued on 3rd July, and in the current year a full grown larva was found on a Casuarina tree as late as the 23rd July. As a female bred out in captivity laid eggs within 24 hours of issuing from the pupal case, it would seem that the eggs are laid in June or July at latest. I have, however, no direct evidence on this point, nor as to where the eggs are laid, as I have not been

able to find them. I am, however, of opinion that they are laid directly on the boles of the trees, generally near the point of insertion of a branch or twig. This I conclude from finding very young larvæ, which must have been recently hatched out, fairly high on the trunks, already hidden in *separate* covered ways.

The earliest date on which the larvæ were observed was 26th August. They feed on the bark, restricting themselves to the superficial layers when very young and gradually working in deeper as they grow. From the very first the larva constructs a covered way made up of particles of its own excrement and bark joined with silk. The diameter of this covered way increases of course with the growth of the caterpillar and extends in length. It may wander in any direction, up or down or horizontally, and may maintain a straight or a tortuous course.

At an early stage the larva constructs at one extremity of the covered way a small chamber under the bark, preferring to locate it in the upper angle formed by the junction of a twig with the bole. Here the grub rests when not feeding. It emerges to feed on the bark immediately surrounding the extremity of the "run," which is built up further as the bark is eaten around it. It apparently feeds at night, as I have never found it by day outside the covered way, nor indeed anywhere but in the chamber described.

The larva attains its full size by March or April, and then prepares the pupal chamber. Up to this stage it has penetrated the bark alone except where an existing hole has been utilised as a resting chamber. If such a suitable hole has been found, this is probably merely trimmed, otherwise the larva, being possessed of powerful mandibles, bores into the wood and excavates a pupal chamber about an inch in depth, and this it enters for the final stage in May and June, pupating with its head towards the orifice, which is concealed by the extremity of the covered way.

It being almost impossible to keep the larvæ alive in captivity, the exact duration of the pupal period cannot be easily observed. The only guide I have to go upon is that among several pupæ

brought to me on the 4th June was one which had not yet undergone the full transformation from the larval stage, and had therefore only just entered upon the pupal one. It remained alive till the 25th June, when it died, having then the appearance assumed by the chrysalis immediately before the imago issues. Hence it may be deduced that the pupal stage occupies from three to four weeks.

By the time the larva has reached its full size it is feeding so deep as to reach the wood, which is here and there exposed. In the current year pupæ, obtained by splitting open felled poles, were brought to me from the 3rd to 5th June, and the moths began issuing from the 7th of the same month. Several died and dried up. This was probably due to their being much shaken, as I had several changes of camp between the 7th and the 25th. Nevertheless some half a dozen moths of each sex were obtained. Two of the males I obtained from Acacia leucophlea trees. By touching the anterior extremity of the pupæ, which was near the surface, they were irritated into wriggling, and this brought them mechanically to the outside. In both cases the imago issued the next day.

It would have been interesting to know exactly how the pest found its way into the plantation as well as into the larger private plantation at Gopalpur (belonging to Mr. F. J. V. Minchin of Aska,) 10 miles distant; in both plantations it seems to have first appeared in 1902. Two other private plantations lying between the two referred to above have so far escaped attack.

The larva feeds on the bark of many grove and avenue trees in the vicinity of the attacked plantations, and doubtless spread from these. So far I have found it attacking the following: Acacia leucophlea, Acacia arabica, Holarrhena antidysenterica, Anogeissus latifolia, Millettia auriculata, Eucalyptus globulus (one). The first in the list is probably its favourite food, as along some of the roads where the species is planted every tree is the host of several of these insects.

As the caterpillars feed on species which contain such apparently obnoxious saps as those of Eucalyptus and Holarrhena,

it is reasonable to expect them to thrive on any other woody species. This question of discrimination as to food plant has considerable importance, as will be seen when protective measures come to be discussed.

Such pictures of the devastating action of this insect were presented to me, it being claimed that whole plantations had been destroyed, that I must confess to very serious alarm when I saw the extent of the attack in the plantation in September 1903. While still holding that a very severe attack is a very great threat to the life of many of the trees, if not of the whole plantation, I do not now think that a comparatively mild one would do much actual damage. I am led to this opinion by the fact that in another small Government plantation though every tree (15 or 16 years old) carried three or four larvæ during the past year, not one seems the worse.

As Casuarina wood is used, here at least, almost exclusively as fuel and never in scantlings, the small bore holes do not depreciate the value.

If, however, a severe attack is experienced so that each tree is the host of a number of larvæ (I found 28 on one small tree between 2 and 10 feet up), it is certain that the damage occasioned will be great, as such trees are liable to be ringed and killed. Even a slight attack, however, will kill young saplings up to a couple of inches in diameter, as was pointed out to me in the private plantation at Gopalpur, already referred to.

An incipient attack should therefore on no account be neglected, but where a plantation is in close proximity to wooded lands or avenues, once *Arbela tetraonis* appears in the tract, it will probably be impossible to keep it out of the plantation altogether. In these parts Casuarina is usually planted along the coast on pure sand in isolated plantations, and this affords protection from invasion to a certain extent, but, as unfortunately demonstrated in the instance under consideration, by no means absolutely.

The above record of observations shows that protection is by no means an easy matter; that probably no thoroughly efficient

action is possible, and further that curative measures must be drastic.*

It is proposed to plant a certain proportion of other species in admixture with the Casuarina (approximately 25 per cent), and this proposal is already being adopted in several Government plantations in the Madras Presidency. In the current year in the local plantation 5 acres outside the regular planting for the year have been planted up with 60 to 70 per cent of Casuarinas and 30 to 40 per cent of Tamarind, Dalbergia sissoo, Thespesia, Populnea Nim and Sapindus trifoliatus.

It is obvious that great circumspection must be exercised in selecting the species so as not to include such as are known to be attacked by the Arbela larva. At any rate, the admixture cannot fail to have a beneficial action in regard to the fungoid disease referred to previously.

It has also been suggested that the introduction of broad-leaved trees in the plantation will attract insectivorous birds. This result may well follow, but in view of the caterpillar's retiring habit I do not think that any birds except woodpeckers could reach it, and it is doubtful that these birds would live so near the sea.

A number of the moths might, it is true, be eaten by birds in their very short season; but here, too, I suspect protection by nocturnal flight, though I venture this statement with reserve. However, the moths bred out in captivity appeared more lively by artificial than by day light, and the only moth (♂) seen in a free state came into a rest-house at night, attracted by the lamp-light no doubt, and I found it at rest on the mosquito net in the early morning.

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* I agree with Mr. Fischer that in the case of severe attacks such as he had to deal with in 1903 this should be so. It should be borne in mind however that such exceptional increases in the numbers of this pest are probably by no means of frequent occurrence. As an instance of how rarely the moth has been taken by collectors I may mention that there were but three specimens in the British Museum Collections in June last, one in the Indian Museum, taken in Calcutta by De Niceville some ten years ago, and one specimen from Ganjam in my collections. In smaller attacks and to keep the insect within bounds year by year I think the method of handpicking by boys should be resorted to.—E. P. S.

As regards other enemies, I regret that I have nothing to record. The larvæ and pupæ kept under observation were quite free from the parasitism by other insects so frequent with other species of lepidoptera. Those larvæ which died in captivity appeared to have succumbed to uncongenial surroundings, dry wood and bark to live in and feed on, in place of green, and the pupæ died off from no apparent cause. I have found no predaceous insects in or near the covered ways, though I have examined a large number; and where small black ants were found haunting a hole occupied by a pupa, the latter appeared in no way inconvenienced. In short, the sole enemy of Arbela tetraonis at present known would seem to be man. As a curative measure, therefore, I do not see any practicable alternative to cutting out all infested trees, and I should be grateful for any suggestion on this point.

The compilation of a list of species which have been seen to be attacked by the pest would be most useful; and it is hoped that others will record their observations.

I think that now Mr. Stebbing's questions, except where they enquire regarding variation according to locality, can be answered as follows:—

1. The eggs are laid on the boles and larger branches at a height of from two to three feet to the topmost woody portions. They are probably laid singly or in groups of a few only. If laid in patches, then only a few hatch out. The number laid by one moth is not yet known; but a captive moth laid about 100 unfertilised eggs in one clump (she was in a small box and could not disseminate the eggs).

2. The larvæ hatch out at the end of August and during September.

3. The young larvæ do not live gregariously; from the first each makes its own covered way.

4. The larval stage lasts from September to May.

5. The pupal stage probably lasts from three to four weeks.

6. The moths appear in June.

Other Forest Officers will probably be able to throw further light on the habits of this pest which, until quite recently, were totally unknown.

P. S.—Since penning the above I have received an interesting note written by Mr. W. A. Stracey, Range Officer, Delta Range, Godavari District, and I cannot do better than quote it in his own words:—

"On my visit to the Kandikuppa plantation on 15th November 1903, I noticed several young trees completely girdled, and many of them were broken down by wind. The trees were also bored near the part girdled. The trees were completely girdled at various heights two to four feet from the ground. The bark and cambium were completely eaten through for a width of two to four inches. The borings in the trees were invariably in the upper part, although one case was noticed where the insect had bored into the stump. The trees above the part girdled were either dead or dying. I had several of them split up and removed. The worms I sent to Mr. Stebbing, who identified them as larvæ of "Arbela tetraonis." Some of the larvæ were evidently approaching the pupal stage. While I was in the plantation I had every tree found girdled cut down, split up and the larva killed. Fortunately the attack was not on a large scale.

"About a dozen plants each were so treated in two coupes, and the supervisor was instructed to do the same whenever he met with a plant attacked. The plants attacked were either those of the second or third year's growth. Very few attacks were noticed in the one year old coupe. In the Bendemoorlanka plantation also the attack was confined to young trees (two to four years old). Attacks on larger trees were not noticed. No attacks have been reported as yet this year."

It is clear that the plantation was saved from disaster by the prompt action taken by Mr. Stracey, the unwelcome guest being fortunately observed when the attack was very slight.

Mr. A. W. Lushington, Conservator, N. C., has endorsed on the above note.

"In or about 1894 the Kara Reserve in Kistna was annihilated by the borer."

ORIGINAL ARTICLES.

A FEW REMARKS CONCERNING THE FORESTS OF THE JARRAH, EUCALYPTUS MARGINATA, AND OTHER SPECIES OF EUCALYPTUS.

BY HERR DR. L. DEILS, BOTANICAL MUSEUM, BERLIN.

I have had the good fortune to spend fourteen months in the forests of Western Australia, from November 1900 to the end of December 1901, after which I travelled about a month in Tasmania to see the forests of Eucalyptus globulus. As some of the Australian Eucalyptus are cultivated in India, I have the hope that a few remarks regarding the constitution of these forests may be acceptable to the readers of the *Indian Forester*.

Eucalyptus marginata, the "Jarrah," is only to be found in the south-west corner of the State of Western Australia. This part of the Australian continent is remarkable for having regular rains during the winter, *i.e.* from April to October, the average annual amount being from 30 to 40 inches. The climatic conditions of this region, then, are very different from those prevailing throughout the arid interior of the Australian continent.

The area covered by *Eucalyptus marginata* in Western Australia is stated to be 8,000,000 acres. In fact, nearly the whole country between the mouth of the Moore River in the north and King George's Sound on the south coast may be described as one vast forest of *Eucalyptus marginata*. Next to the world-famed gold mines of the interior, these forests constitute the principal wealth of Western Australia.

The industry built upon it is steadily increasing. The beautiful red timber, so highly prized for paving blocks, is a conspicuous feature of Western Australian scenery. It meets your eye everywhere ; all houses are built of it ; planks and scantlings in huge piles are to be seen at the Railway stations and on the jetties for

export. It is never attacked by insects, and it is suited for all kinds of out-door work. Hence it is the staple timber of Western Australia.

In the lowlands between the coast and the inland plateaux, which are on the average about 20 miles wide, jarrah does not form compact forests, but grows scattered on the sandy plains, overtopping an undergrowth of two stories: a few small trees or tall shrubs—chiefly Proteaceæ—forming the upper story and an endless variety of low bushes with rigid branches and hard evergreen leaves the lower one. In these localities the jarrah has somewhat the shape of isolated oak trees in English parks, with spreading branches and broad crowns. Thus we see it near the lower Swan River; it gives the scenery round the city of Perth and suburbs its peculiar character. In this part of the country the trees are allowed to grow and are not utilized on a large scale.

The commercially important forests commence on the hills which form the western slope of the huge tableland of Australia. Here the appearance of the forest is gradually changing. The number of trees per acre increases rapidly; the elbow-room being less, the trees are growing taller, and, at the same time, the crown decreases in volume. The result is a dense and generally pure forest of this species.

Needless to say, this is brought about by a change of the external conditions. Here we find what is well known in all parts of the globe: the moist currents which come from the sea are compelled, when ascending the ghats, to give off part of their moisture. The rainfall is increasing. The soil, not being sandy, consists mainly of the gravelly détritus of the underlying granite, usually called "ironstone-formation."

Under such conditions the jarrah is seen at its best. The trees, attaining 90—120 ft. in height, are fairly well provided with foliage. Apart from an addition of *Eucalyptus calophylla* in places, there is no other arborescent species in these forests, the chief undergrowth being the younger generations of the jarrah itself.

This extraordinary uniformity of the chief constituents of the forest is in striking contrast with the endless variety of small bushes, about 1½—3 ft. high, which cover the whole ground with their evergreen foliage, and adorn it, during the rainy season, with the rare splendour of their flowers.

This feature makes the jarrah forest very different from the type of Eucalyptus forests common on the tableland of the Eastern States of Australia. In these regions the forests are more open. The ground is covered mainly with grasses and annuals, which make their appearance in the rainy season. The green carpet beneath the lofty trees gives a very pleasant aspect to these forests during the wet months, but it vanishes rapidly as soon as the hot weather approaches.

Even more different is the aspect of the jarrah forest from the woody vegetation of the central portions of Southern Australia. For in these desert regions the scrub mainly consists of various low-growing, almost shrubby, species of *Eucalyptus* and *Acacia*, growing intermixed.

It is not very difficult to recognize *Eucalyptus marginata* in the genus. The trunk is covered by greyish brown bark. The leaves show the common shape of Eucalyptus, drooping in the adult state of the tree but being erect on the young plant. Otherwise there are no pronounced differences between the young foliage and the old.

The conditions which regulate the production of flowers and seeds have not yet been sufficiently studied. I have seen flowers on medium sized shrubs of jarrah of apparently quite a young age. In other localities tall trees only produced flowers. I have found flowers in November, June, and occasionally in other months of the year, but never very plentiful. I was told, however, that from time to time, as is the case with the beech and other forest trees, a heavy seed-year occurs, when the whole forest is said to be one mass of white flowers.

As mentioned above, *Eucalyptus calophylla* is the only species to be met with as a companion of *Eucalyptus marginata*. Never constituting a forest by itself, it is intermixed freely with *Eucalyptus*

marginata or a few other species of more social habits. When growing isolated, *Eucalyptus calophylla* has a most beautiful appearance, strikingly similar to the oak in Richmond Park.

As indicated by its name, the foliage is the principal adornment of this fine species: it is very dense and of a rich green colour. The shape of the leaf, as well as its nervation, are of a type not common in the Eucalyptus genus. Still more extraordinary, however, is the position of the leaves towards the light. While most of the other Eucalyptus have their leaves drooping or erect, that is, vertical, the leaf of *Eucalyptus calophylla* is horizontal, following the habit of the vast majority of trees. It follows that *Eucalyptus calophylla* is a much more shady tree than most of the other species.

The shape of the large flowers and fruits also is nearly unique in the genus. It is certainly one of the most distinct species of Eucalyptus indigenous to Western Australia.

Economically, *Eucalyptus calophylla* ranks far below *E. marginata*. Still it is very ornamental; the gum-resin is valuable on account of its medicinal properties, and the bark is used for tanning. The timber is much inferior in quality to that of other species.

Another important species of Western Australia is *Eucalyptus diversicolor*, the "karri." It is perhaps the finest tree of the country. The trunk is very straight. The smooth bark peels somewhat like that of the plane; it is always white and clean. The height of the tree is unsurpassed in Western Australia, and equalled only by *Eucalyptus amygdaline* of the south-east corner of Victoria. Specimens about 200 ft. high and 40 ft. in diameter at 3—4 ft. from the ground and about 120—150 ft. to the first branch are by no means uncommon; much larger trees, up to 300 ft. high, have been actually measured.

Eucalyptus diversicolor has a very limited geographical area on the south coast of Western Australia, from Cape Leeuwin to King George's Sound. This is the wettest part of Western Australia, where the dry period of the year is less pronounced and the heat of the summer considerably reduced. A narrow strip of land along the coast is covered by forests of this gigantic tree

The finest growth is to be seen on rich "ironstone" soil. The forests of karri are just as pure as those of jarrah, while the undergrowth is of a similar description.

In conclusion, I may be allowed to add a few remarks regarding the natural conditions of the forests of *Eucalyptus globulus.* This species, the Eucalyptus best known outside Australia, enjoys conditions of life more favourable than most of its congeners. It is indigenous to Tasmania The more or less periodical rains of continental Australia are here, on this mountainous island, replaced by a fair rainfall all the year round. Hence the appearance of the woods of *globulus* is different from most continental types of Eucalyptus forest.

In Tasmania the enormous columns of the dominant tree reach a height of above 200 ft., the drooping foliage spreading a light veil above the umbrageous trees of the undergrowth. This lower story is much more conspicuous than anything in the continental forests. First, there are the saplings of *globulus* itself, with their strange glancous foliage, so utterly different from the narrow alternate petiolated leaves of later life. Then there are a number of pretty trees with soft foliage, many of which are remarkable for their affinity to species of the Indian Archipelago. Among these are often fine specimens of fern-trees, species of *Dicksonia* and *Cyathea*, their black stems completely covered by filmy ferns, mosses and liverworts. The ground is hidden by fallen logs and branches, with thick layers of moss upon them; by huge tufts of ferns growing between, and by tall herbs rooting in the deep black soil. Altogether, the primeval forest of *Eucalyptus globulus*, with its harmonious combination of every possible shade of green, makes one of the grandest pictures of vegetable life, quite unlike any tropical scenery, and at the same time entirely different from anything which makes the forest of the more temperate zones so delightful.

Our illustration shows the growth of *Eucalyptus globulus* at Ootacamund which, we think, will prove of interest to Dr. Deils and our readers. It is reproduced from a photogragh very kindly taken by Mr. H. Jackson, I.F.S.—HON. ED.

RIVER PROTECTIVE WORKS AT DEHRA GHAZI KHAN.

BY G. M. RYAN, F.L.S., I.F.S.

"It has been decided by the Government of India that no more money shall be spent on protective works at Dehra Ghazi Khan." Such is the announcement which appears in the issue of a contemporary of the 28th July last, and it is reproduced in order to draw attention to the general policy of the P. W. Department in dealing with the protective works on the Indus, a policy which, it is urged, is not based on sound economic lines.

Large sums of money were spent in endeavouring to save Dehra from destruction by flood and erosion, and the expenditure of further large sums was contemplated. A Sind Engineer's services were, however, brought into requisition, and he advocated a relatively inexpensive scheme of protection. This was tried, but failed. Now it has been apparently decided that all further attempts to protect that military station from destruction shall be abandoned, and if such is the case, the question arises, could not this have been foreseen at the outset?

Although I have not visited Dehra Ghazi Khan, some years ago I made a study of the history of the Indus, and was able to form certain conclusions about the laws governing its vagaries; and these subsequent results seem to have confirmed. I think it is possible to lay down a few broad principles for guidance in regard to the erection of protective works along both banks of the stream, which might be followed.

In an article published in the *Indian Forester* in 1896 (Vol. XXII, page 119), entitled "The River and the Best Method of Embanking it," I attempted to show how the various belts of vegetation along the Indus in Sind came into existence and were arranged as it were in a *natural order* along both its banks, and how futile it was to erect embankments as protective works counter to their gradual development.

The risks run by persisting in the present bund policy were also pointed out; that no properly thought out working plan existed for protective works on the river; that one Engineer put into operation a scheme in his Division, the full details of which

were unknown perhaps to the officer of the adjacent Divisions; and that works in one locality naturally had a prejudicial effect on the protective works in another.

Although the observations and conclusions in the article alluded to refer almost exclusively to Sind, and although Sind and the Punjab are two different Provinces, the geological character of the flat alluvial plain through which the Indus runs in both is so similar that the arguments which have been used in support of the contention in the one case could be made applicable in the other.

That the conditions are somewhat analogous is borne out by the fact that a Sind Engineer was ultimately brought in to try and grapple with the problems at Dehra Ghazi Khan.

I need scarcely say that my criticisms are made in no hostile spirit to the great P. W. Department. My contention is that the bund policy in Sind tends to raise the level of the sectional area of the river within the bunds, and that when this area has been gradually elevated, the stream proceeds to swerve to a lower level, which is, of course, outside the area of the bund, and that no amount of works of protection will prevent erosion of the banks when the river has thus made a *set* on to them. This is what, it is to be supposed, happened at Dehra Ghazi Khan, and if the P. W. Department had properly grasped the situation the futile attempts to stem the onward march of the river would never have been made.

The elevation of the sectional area of the river between the bunds is a factor in the question which the P. W. Department do not accept. So far back as in 1896, when the matter was broached to an experienced Engineer in Sind, he replied "that the embankments raise the river level is certainly open to doubt except in areas subject to tidal influence." If doubts existed eight years ago, have any data been obtained since to disprove the theory? According to Sir Evan James, Commissioner in Sind (see remarks later on), Government in 1896 were going to appoint a special officer, whose sole charge was to be the Indus, to watch its vagaries and ascertain if there were any laws under which it acts. If this officer was appointed, as presumably he was, he might be able now to throw some light on the subject, and it would be interesting to

hear whether my observations and conclusions are confirmed or not.

The embankments which were laid down everywhere in Sind up to the time, at any rate, when I left that Province, *viz.*, 1897, were aligned without a thought apparently beyond present necessity. This is surely not the correct policy.

This plan of closely hemming in the lateral overflows of the Indus by high earthern embankments is one that affects forest officers in Sind especially, for the building of these walls close to *the cold-weather course of the river in that Province causes the* forests situated outside that wall to be shut off in the flood season from the water-supply to which they are legitimately entitled, and loss of irrigation facilities for the forests means, of course, their practical extinction. My letter already alluded to was written with the object of drawing attention to this matter. I see from the Sind Annual Administration Report for 1901-02 that this question was still under discussion. The Conservator in alluding to natural regeneration, para. 44, wrote—"In perhaps half the forest area, having only its natural difficulties to contend with, a satisfactory and, in some cases, excellent natural regeneration is present. In the other half of the forest area there is little or no regeneration either because the land is above flood level or because some bund or *canal bank has made a desert of it.* I am making a special representation to Government on this point." And again (para. 95)—"The progressive deterioration of the forests due to constantly increasing bunds and canal banks has naturally produced a state of moral weakness and want of confidence which results in babul lands being sown with inferior but hardy khandi rather than risk disasters like that of Miani or the simple failures that have been so frequent."

The Commissioner, Mr. Cumine, in reviewing Mr. Gleadow's report wrote—"The question whether, now that the flood waters have been so much cut off by 'bunds' from the forests that lie back from the river, there ought not to be a definite irrigation scheme worked out for each such forest will engage the attention of the Commissioner during the present touring season."

If the bund policy of the P. W. Department as regards the erection of embankments is to be persisted in the only alternative would appear to be Mr. Cumine's very reasonable suggestion.

Since writing the above, telegraphic news has reached the Bombay papers that the Kushmore Bund, which is at the extreme north of the Province of Sind, and which is an important work intended for the protection of the Jacobabad and Shikarpur districts, has been breached. The breaching of this bund is a very serious matter indeed. During the inundation season the Executive Engineer of the district is under the necessity of residing close to it, or practically on it, and a small army of men are entertained to patrol it night and day, in order that any damage may be promptly reported and repaired. That a serious breach under the circumstances should have taken place indicates either neglect on the part of the local staff to do their duty satisfactorily or that the damage was out of their power to prevent; and it is thought the latter is probably the correct explanation of the case.

Admitting the latter explanation, the increased apparent height of the floods in the vicinity of Kashmir, compared to those of previous years, seems the obvious explanation, and this is yet another argument in corroboration of the theory regarding one of the direct effects of the protective works on the Indus.

The P. W. Department are apparently quite satisfied because by their policy Government are realising by the embankment system in Sind a profit of 11% on the capital outlay (*vide* para. 12 of the Sind Administration Report for 1893-94 quoted in part in the *Indian Forester*, pages 57 and 58, Vol. XXII), but this figure does not indicate the real state of things. It is based merely on the profits realised from assessment on agricultural land, and the enormous losses by erosion of valuable forests, which it has taken a century or more to rear, and which were (in 1894) comparatively the most valuable per acre in India (*vide* para. 119 of the Sind Administration Report for 1893-94), are not taken into consideration; neither are the losses resulting from shutting off the water-supply from extensive

tracts, forests or otherwise, which are thereby rendered sterile, being covered with salty efflorescence.

In 1894 the question of placing the bunds much further back from the cold-weather course of the river was raised by myself, and the Commissioner in Sind, Sir Evan James, who was sent a copy of my notes on the subject, wrote very courteously as follows :—

"The bund policy that has been followed in Sind of late years was called in question by Mr. Joyner and thoroughly gone into and decided upon by *Government not long ago. I think, therefore, it* is unnecessary to raise the question again. Government are going to appoint a special officer, whose sole charge will be the river Indus, to watch its vagaries and ascertain the laws under which it acts. As a matter of fact, in the matter of bunds as in everything else, we have to cut our coat according to our cloth. Bunds are enormously extensive, and the further away from the river the more they cost, as the river runs along a ridge,* and bunds in lowlying ground are extremely expensive to build and maintain. Of the merits of the policy pursued, the revenue returns are the best proofs. The more care taken in repairing and extending bunds, where found necessary, the greater and steadier has been the increase of revenue, *i.e.*, of cultivation. The uncertainty attending all cultivation and the loss and misery that results therefrom would be so enormous that any attempt to dispense with bunds would be quite out of the question.† Admitting, then, that bunds are necessary, the question of where to place them depends mainly on the set of the river, the height of the land, and the money available. No doubt to you as a Forest Officer it would be pleasant to have a large forest-clad area on both sides of the Indus, but it would not be pleasant to the owners of the present lands to see their property practically destroyed."

I also submitted my notes together with Sir Evan James' *reply to Mr. Young, one of the ablest Engineers of the Province,*

* In my paper on the best method of embanking the Indus this is all shown in diagrams.

† The abandonment of bunds, as will be seen from my paper, is not advocated.

P. M. Lushington.

Photo. The Growth of Spike in Sandal. S. B. Mondul, del.

at the time, and although I am precluded from quoting all what Mr. Young said, because he has since retired and I have not his permission to quote his remarks, which are marked private, he stated that the Commissioner had given a very fair, concise and correct reply to my plea.

This being the opinion of the P. W. Department, it can only be repeated that their policy of trying to hem in closely the lateral overflows of the Indus does not appear to be invariably based on sound economic lines, and with the Dehra Ghazi Khan example before us, it would seem that the bund policy is scarcely one to be blindly followed. If my remarks meet the eye of any P. W. Department Engineer, it would be interesting if he would give us his side of the case in the pages of the magazine, taking this article in conjunction with my previous one.

The absence of vegetation along both its banks and the character and disposition of such vegetation, if existing in almost gregarious belts, form a valuable index as to the best and most economical alignment to be followed in the long run for its embankment system, and until the P. W. Department realise this, it is believed that success in grappling with the Indus River problems can never be satisfactorily achieved.

SHIKAR AND NATURAL HISTORY NOTES.

A TRIP IN CANADA.*

THE LUMBER TRADE ON LAKE HURON.

BY COL. G. F. PEARSON.

Parry Sound is the great centre of the lumber trade on Lake Huron, and my old instincts have brought me here to see how they do things. Here conservancy is truly at a discount, or rather of no account at all. There are three great companies at work, all busily engaged in cutting up trees into planks and scantlings at a rate that can only be realised by those who have seen it. I have just been over the works of the Parry Sound Lumber Company, which are the most up-to-date, and do 140,000 superficial feet of sawing each day of 10 hours--partly planks, partly scantlings. I have never seen, either in the Black Forest or elsewhere in Germany or France, anything to approach their machinery for simplicity and practical efficiency. The whole is driven by a horizontal 750 h. p. steam engine, which works beautifully. The smaller pieces are cut up

* Extracts from letters written to Mr. Eardley-Wilmot, Inspector-General of Forests, which he very kindly placed at the disposal of the Hon. Editor.

by a series of parallel chain saws, which drag the logs in sheets against the circular saw. But the most marvellous piece of machinery I ever saw of the sort was the heavy steel table which carried the heavy logs and worked backwards and forwards against a huge saw, which ripped through them as if they were butter. Two men only stood on the table to work the levers; a log was brought in on a trolly dragged by a chain; it was rolled on to the table, gripped by the levers, the side slit off, turned over and squared, and finally cut up into planks or scantlings in far less time than I have taken to write this, each plank being thrown out and put aside much like the sheets of the *Times* are thrown out and folded in the *Times* Printing Office.

Just think of the destruction of forests at about a million feet of sawing per week in this mill alone, and there are three big mills here all going, besides smaller ones. It must be a thriving trade too. Just now all sections of the trade are working at high pressure, and good lumbermen—the experts at the work called "Gangers"—are earning 100 to 120 dollars a month, that is, about £20 to £25 a month. Ordinary lumbermen get commonly 30 dollars a month and their keep, which in the forest comes to about another 23 dollars a month. From this you may judge the importance of the industry, and of how little use it is to talk to people here about their real interest in conserving the forests as the richest capital in the country. They assent to this at once when you talk to them, but they say that present interests are too great to think of it. You might as well talk to the coal owners in South Wales on the subject of preserving their precious supply of steam coal, which is unique in the world. Government is powerless to interfere, as private interests are so strong and so many thousands of men get their living by the works in either case. But it seems to me a sad thing that nothing can be done to regulate this fearful expenditure of capital.

The lumbermen are a rough and hardy lot of men and work all the winter in the forests, as all the timber is brought to the river over the snow. The men who work in the mills at Parry Sound get 1·50 to 1·60 dollars a day and keep themselves,

which they do for 15 to 16 dollars a month, so their pay is about the same as the others—about 8*s.* 6*d.* a day. But they work ten hours for it, and work hard, which men won't do in England. Some of these men are wonderfully clever at their work, as I saw myself. You can hardly imagine what a rate the machinery moves at. As soon as the log automatically appears on the table, the man in charge has to estimate what it will cut up into, and as soon as the first side is ripped off, he sets the machine accordingly, and it is cut up. There seem to be few mistakes and no waste.

Sleepers, or "*ties*" as they call them here, are never sawn. They say they last twice as long if not sawn; they just take a tree about three-feet girth and cut it into lengths and roughly square it with an adze, and sometimes only just cut a place for the chairs.

The Manager of this great concern was a young fellow hardly over thirty, who had the direction of the whole works. He was most kind and civil, and a very clever intelligent man, full of interest in his own work and keen to hear about our work in India. I do not know what pay he received, but it was probably well over £1,000 per annum. He was a highly educated man, though he was dressed like and had the appearance of an ordinary lumberman.

The whole place is unique. It is like a typical backwood settlement on the shore of Parry Sound. All round, you may say for miles, you see nothing but lumber stacked up, which tugs and barges come to tow away; or it goes by rail from Rose Point close by. Most of the wood here is white pine, but there is a little red pine and hemlock.

Wood here is truly like gold and silver in the days of Solomon—"of no account." It seems to offend one's senses to see the waste. Walking round there are in every cove and every inlet and at every little stream hundreds and thousands of logs and even planks and scantlings in every stage of rotting away, and no one thinks it worth while to collect them.

There are a few good houses and stores, barber's shop, Methodist and Baptist chapels, etc., but most of the place is saw mills and rough shanties in which the lumbermen live. The Hotel

is quite a decent one, but very noisy, people coming in and walking about and having drinks and talking till after 1 A.M. at night.

To-day we go to Rose Point, which is a pretty quiet place round the corner of the Harbour, where they say there is a comfortable quiet hotel. Coming up here in the steamer from Pennetang on Lake Huron, which is about three hours by express train by rail from Toronto I put up at a hotel on an island which belongs to (and the hotel is run by) Colonel Cautley, of the old 97th (now West Kent) Regiment. He is a grandson of Sir Proby Cautley, who built the Ganges Canal, and nephew of General George (Bengal Corps) and Colonel Dick Cautley, who used to live in the Dún. I spent three days very pleasantly there.

If you ever came this way I should advise your going to the Rose Point Hotel, a couple of miles off, a pretty quiet place, served by a launch which runs up the Harbour continually.

A DEAD ELEPHANT.

A letter in your number for June 1903 *re* a dead elephant has reminded me of a case I was unable to account for.

A timber working elephant on *must* and doing serious damage was shot in the hind leg. He was then fettered and turned into the jungle to recover, and after being there over a month was very nearly well enough to travel and get to work again.

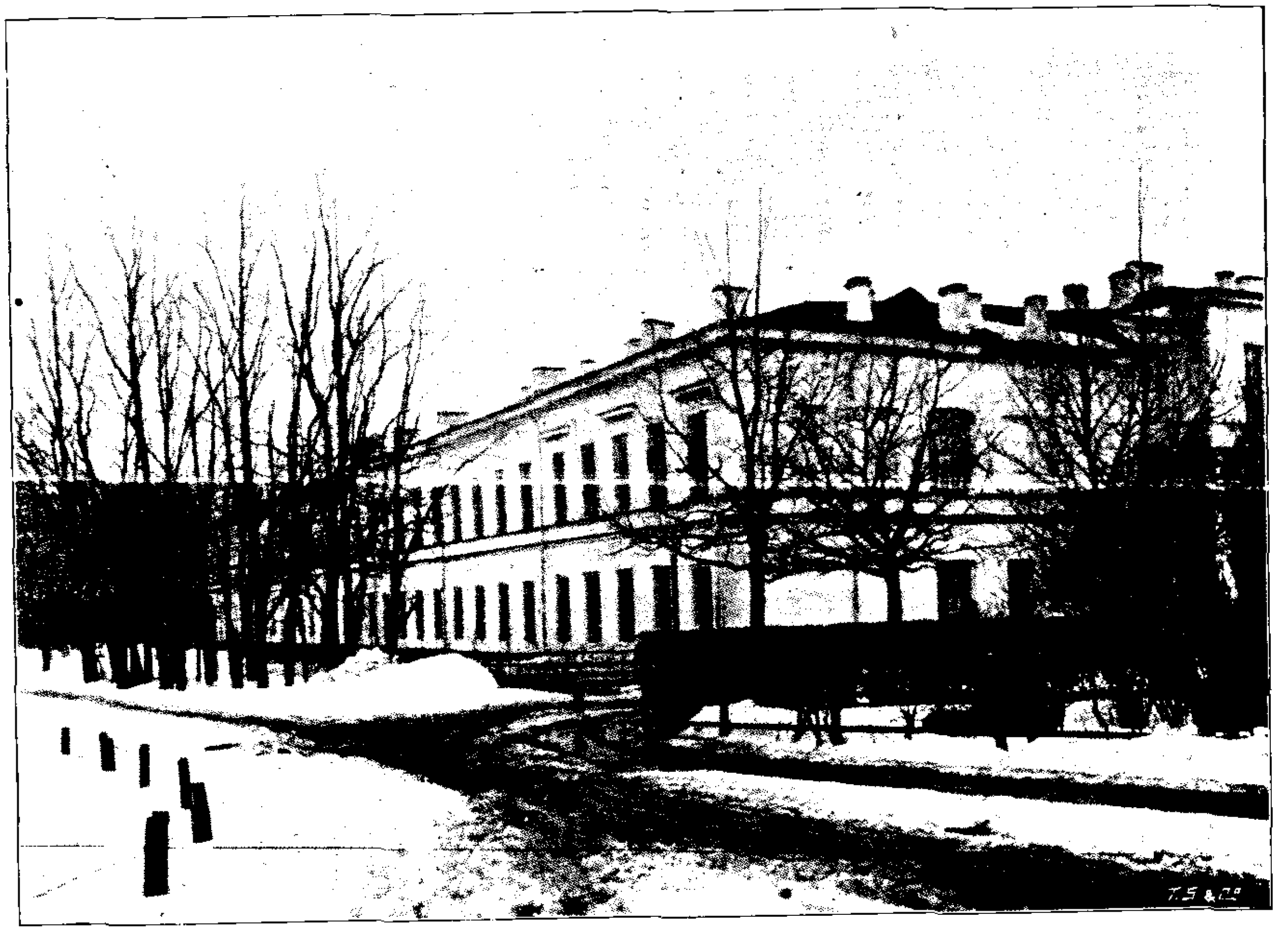
The mahout saw him one evening, and next morning found him lying on his back, in a dry buffalo wallow, dead with his feet in the air and trunk spread over backwards as described in the letter referred to. No reason could be given for his death.

Unfortunately I could not get there in time for a *post mortem*, but up till the time of his death he had appeared quite fit and the wound was doing well. The wounded leg showed no signs of anything wrong and the bone was quite sound.

The only reason I could think of was that he had been sleeping by the buffalo wallow, had rolled into it and had not been able to right himself as his leg was still weak. In consequence he could not get off his back, and like a sheep when "cast" had died from the effect. Is this a possible explanation in this case and the case referred to in the former letter?

L. VALE BAGSHAWE,
Bombay-Burma Trading Corporation,
Kindat, Upper Burma.

22nd October 1904.



Imperial College of Forestry, St. Petersburg, Russia.

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THE IDEAL FORESTRY COLLEGE.

GENERAL REMARKS.

HAVING recently had the opportunity of visiting some of the best Forestry Colleges and Institutes existing in Europe, we have thought it might serve a useful purpose at the present juncture to give, within the limits of a short article, our impressions as to what an ideal Forest College or School should be, the said views being based upon a careful selection of the best points seen in the various institutions visited. That these deductions have had to be entirely drawn from continental experiences is due to the well-known fact that the British Empire is still without a representative Forest College, even the Forestry branch built up at Coopers Hill being now in the final stage of its existence. *In formâ pauperis* the Department now awaits the Government decision as to the nature of the establishment which is to rise on the ashes of Coopers Hill.

It is well understood that it is not essential that all forestry institutions should be equally provided for in the matter of staff and equipment, since their scope varies greatly; some are devoted to the training of the superior staff, whilst others concern themselves solely with that of the subordinate one. A primary object of all tuition given in a College or School which endeavours to inculcate the principles of forestry and forest work is that the greatest attention should be paid to training the powers of observation of the student to their highest possible pitch. That this should be done is needful for superior and subordinate alike: for the faculty of true and close observation and deduction from observation is the fountain head of all forest education. In all forest educational establishments therefore it is needful to supplement

the lecture room by the laboratory and the laboratory by the museum, and all three by liberal practical work in the field. Whilst the following article more particularly considers the arrangement and contents of the Forestry College required for the education of recruits for the Upper or Controlling Service of the Department, much that it contains will be found to apply to those institutions whose scope is limited to the training of the subordinate ranks.

In describing the requirements which we deem essential for our ideal College we will consider the matter under the heads of Situation, Buildings, Staff, Studies, arrangement of the main educational building (its libraries lecture halls, laboratories, museums, Professors' rooms, etc.), College Gardens and College Educational Forests.

SITUATION.

The first question which arises in connection with the formation of a Forest College is its situation. It is necessary that it should be placed in the vicinity of wooded areas, and the more plentiful and varied are these latter the better for the purpose in view.

It should be possible for the student, within the limits of short walks, to study the commoner species of trees, shrubs and herbs, the zoological *fauna*, etc., with which he is beginning to make acquaintance, perhaps a first acquaintance, in the lecture room ; for under the present existing entrance examination for the Imperial Indian Service there can be no certainty that a forest probationer has even the most elementary acquaintance with Nature. To plant a Forest College in a flat, treeless country would be to damp the ardour of the student at the out-set, just at the very period when it is most essential that it should be stimulated. Coopers Hill in England and Tharandt in Germany serve as excellent examples of what the environs of a Forestry College should be like.

BUILDINGS.

To be of the fullest use the College should be *self-contained*; in other words, not only the students but the major portion of the Educational Staff should dwell within the College precincts. For

this purpose several blocks of buildings are required. First and foremost comes the main educational building. This should contain, on a liberal scale, lecture halls, museums, laboratories and Professors' and Students' working rooms. In addition to the main building there would be, in the grounds, suitable quarters for the Director of the College, with separate blocks of quarters for the resident Professors and the students. It is better for these latter to reside in a building apart from the main building if feasible. In the grounds would also be situated a good gymnasium and open areas for recreation purposes.

STAFF.

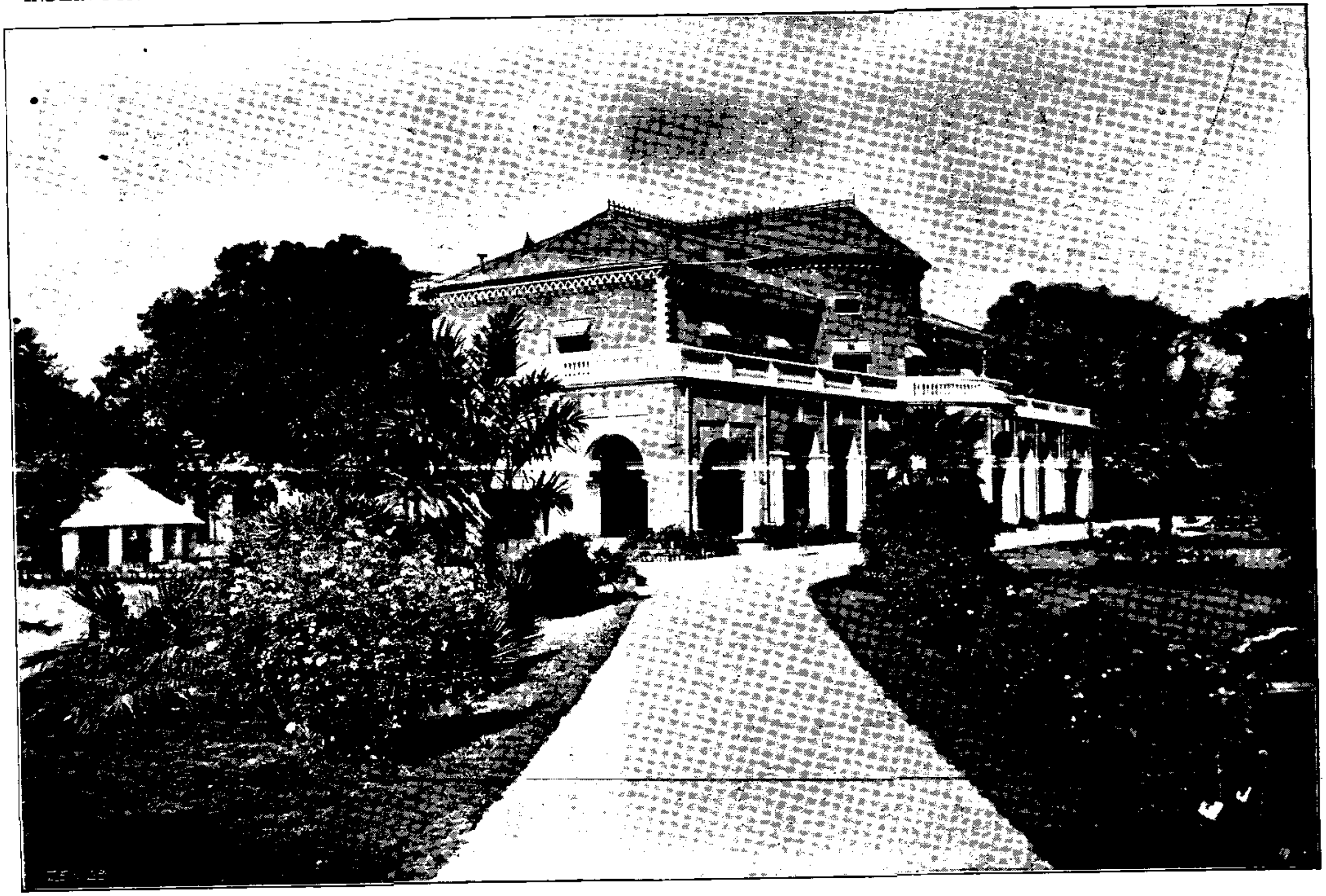
The question of staff is one which must ever be placed in the forefront where any educational establishment is under consideration, for efficiency is so often made subservient to a cheese-paring economy, and the finest College in the world is useless unless properly manned with the necessary number of Instructors. It is well understood that no one can teach with any degree of satisfaction or usefulness any subject other than his own, and this is perhaps more especially the case when the subjects are scientific ones. Both in the French and the British Institutions we have examples of a false economy necessitating the one Professer teaching both his own particular subject and one or more which he has had to 'get up' in order to lecture upon them. The students can easily distinguish between the two. The one subject they really learn something about. In the others *damnunt quod non intelligunt* very well expresses the attitude taken up.

In addition to a Director, who would be in charge of the whole institution, together with its instructional forests, we consider our staff requires nine Professors, who would deliver lectures in Forestry in all its branches, and Forest Law, Botany, Zoology, Chemistry, Surveying and Forest Mathematics, Geology, Mineralogy, Physics and Drawing. As examples of Colleges provided with such staffs we may instance Tharandt in Germany and St. Petersburg in Russia, the latter, however, owing to its much greater size has twelve Professors. Many of the Professors require assistants, who are responsible more or less for the museums, for the setting up of specimens, putting

them out for exhibition at lectures, and for assisting the students when visiting the museums out of lecture hours. In the German Schools we find that each of the Professors in Botany, Zoology, Chemistry and Physics, at least, is provided with such an assistant, whilst in the St. Petersburg Institute, where there are 500 students, all training for the Upper Controlling staff, there are no less than 15 assistants. The importance of having such subjects as (we of course need not allude to Forestry) Botany, Zoology, Geology and Chemistry taught by specialists in these subjects and of providing them, where possible, with assistants cannot be too strongly advocated. In Germany these latter are often students of the College who have finished their course but, having shown a special aptitude for some particular branch, are kept on a year or so longer; they will eventually either go into the forest or replace the Professors in their own or similar educational centres. Whilst this latter would not be feasible at present in the case of a British College, it would, we think, be quite practicable to keep on a promising student for a couple of years or so, allowing him to draw the pay and allowances of his rank, whilst thus qualifying himself as a specialist in his particular branch. The work such a man would do when he eventually joined the Department would well repay the extra educational advantages afforded to him, whilst he himself would be of the greatest use to the students in residence during the years of his extra deputation.

CURRICULUM.

There is little necessity for considering here the subjects which it is essential for the future Forest Officer to study at College: they are well known. There are, however, two points which may with advantage be touched upon. The first is connected with the knowledge possessed by the student when he first enters the College. Few who have studied the question at all can doubt that he should come in with an elementary knowledge of Botany and Applied Science, including an elementary course in Zoology and Anatomy. Further, that he should have a liking for scientific subjects. That a student entering a Forestry College with a knowledge of classics and perhaps of modern languages only is more



Imperial Forest School, Dehra Dun, India.

than likely to prove a lamentable failure as a Forest Officer will perhaps surprise but few save the Public School Master. The second point more particularly applies to our British Schools of Forestry, and it concerns the instruction given in the subject of Forest Zoology. The importance of this branch of the work has had but little recognition, and the tuition in it has been of so inadequate a nature as to preclude the student from attaching to the subject in his after service the importance which it undoubtedly deserves, and which it receives in Germany, France, Russia and Austria.

THE EDUCATIONAL BUILDING.

We will now consider briefly the arrangement of our main building. We have already seen that it will consist of libraries, lectures halls, museums, laboratories, Director's and Professors rooms, etc. Following the plans of the best continental Colleges, the rooms devoted to special subjects will be arranged in suites so that the lecture hall appertaining to a particular subject will have the museums, laboratories, etc., of that subject contiguous to it.

THE LIBRARIES.

The general library of the building will contain a complete set of works on Forest subjects, both in the language of the country for which the College serves as an educational institution and also in those of all the important forest-conserving countries of the world.

That such a library should be as extensive and as up to date as possible would be a *sine qua non.* This library would be directly under the administration of the Director, but would be available daily to professor and student alike. In addition to this main library each professor would have his own special one in his working room, containing such works of reference as he constantly required. All more costly and rarer works would find their place in the general reference library.

THE LECTURE HALLS.

In so far as practicable each subject should be provided with its own lecture hall, and this more especially applies to those subjects in which the lecturer requires to show a large series of

specimens during the delivery of the lecture or to prepare series of experiments. Thus, for example, separate lecture halls should be provided for such subjects as Botany, Zoology, Chemistry and Physics, to mention a few. Where, through economy, it becomes necessary to use the same lecture halls for several subjects, the different lectures, coming one immediately after the other, necessitate the professor curtailing the number of his exhibits owing to the impossibility of getting them into the hall and arranging them in time for the lecture. This in itself, since it is a disadvantage to the student, is a sufficient plea for the necessity of separate halls. Where possible the lecture halls should be so disposed that they may open out on the one hand into the museum devoted to the particular subject and on the other into its special laboratory.

THE LABORATORIES.

It is scarcely necessary here to dwell upon laboratory requirements. There are few branches of science in which a laboratory or practical working room is not an essential part of the instructing staff's equipment. For convenience it would be so arranged as to be contiguous, or as adjacent as possible, to both museum and lecture hall. In the German Schools separate laboratories are provided for Botany, Zoology, Chemistry and Soils, and Physics.

THE MUSEUMS.

In all educational establishments where any subject which treats of the constitution of the world we live in, its structure and rocks, its fauna and flora, etc., is dealt with, a first desideratum is a good Museum. But although latterly this has come to be recognised to a certain extent in the British Empire and has long been fully understood by the more enlightened continental nations, the object in view is often defeated by the internal arrangement of the museums. It is considered that all that is required is that collections should be made or bought and placed in the room or rooms set aside for museum purposes, without any particular attention being paid to the proper grouping together of the various objects exhibited. For instance, a collection of butterflies will be

shown alongside specimens of pickled fungi; jars of pickled fish mixed up with lizards and scorpions, also in spirits, whilst a series of spirit specimens of beetle and moth larvæ will be placed amidst a collection of mineralogical and fossil specimens. To the student new to all these various objects their appearance leaves but a confused jumble of objects on the brain without the possibility of his acquiring a true knowledge of their proper place in Nature's Kingdom. Even the more experienced worker cannot but find his attention wandering when, wishing to study botanical specimens, he finds them mixed up with zoological or mineralogical ones. For a Museum to be of real service it is absolutely essential that each of its branches which deals with a special subject such as, *e. g.*, forestry, botany, zoology, mineralogy, chemistry, physics, etc., should be kept distinctly apart. In our College we would have separate rooms or suites of rooms for each branch. If it is possible to so arrange that each Museum is contiguous to the lecture hall and laboratory to which it belongs, the ideal will have been attained; this latter exists in the Tharandt, Munich and St. Petersburg Forest Colleges. Coming now to the subjects which should be given separate Museums in, if possible, separate rooms (if the latter is not possible some method could be easily devised to sharply mark off each separate branch so as to avoid all chance of confusing the student, provided that sufficient space is available), we have the following list:—

1.—*Forest Woods (including forest fungi and examples of hypertrophy).*

A complete set of specimens of the woods of the country would be shown both in the form of hand specimens and in larger blocks so that the student could come to recognise the appearance of the wood in bulk; these large pieces would have the bark on one side in order that the student could become familiar with its appearance. A collection of the commoner forest fungi and examples of hypertrophy in woods would also be included here for the use of the Forestry lecturers on these subjects.

2.—*Forest Instruments aad Models.*

This collection would be made as complete as possible, but

it would not be necessary to include in it inventions which have not come into practical use in the forest. The number of such is already too large to prove anything but confusing to the student. The collection of models would to a certain extent depend upon the configuration and forests of the country for which the Museum is being made.

3.—*Forest Wood Craft.*

A complete set of shooting and hunting implements would be shown, special attention being made to exhibiting those in use by poachers in the forest areas so that the student might become acquainted with their appearance. The different kinds of bullets, sizes of shot, and the various animal traps, fish traps and nets, etc., would also be shown. Further, a complete set of the slots of the animals common in the forests of the country would be prepared for the student's use. These can be easily made by taking or obtaining impressions of the foot-marks in sand mixed with a certain amount of gum. This Museum might be included in the Forest Instruments Museum or be placed in No. 4.

4.—*Forest Products Museum.*

In this Museum would be shown all the minor products which the forests produced, as also examples of the various ways in which the various woods and products were used, such as, *e. g.*, joinery, agricultural implements, wood toys, tannins, fibres, lac, dyes, etc., etc.

5.—*Botanical Museum.*

This Museum would contain a set of hand specimens of the woods of trees and shrubs and a series of the fruits and seeds of trees, shrubs, and herbs; specimens of tree and plant fungoid diseases and examples of hypertrophy. Also a herbarium and, if considered useful, some models showing the structure of the different parts of plants. Also a complete set of fibres.

6.—*The Zoological Museum.*

This would be divided into three parts. The first would comprise a complete collection of objects to illustrate the lectures given on the Animal Kingdom as a whole, only representatives of each class or group being exhibited. The second part would show

a representative collection, named throughout, of all animals to be met within the forest areas proper, in open woodlands, grass lands contiguous to forests, in fact all the animals which the Forester is likely to meet with in the course of his daily work. The third portion of the Museum would be the Economic Section. In this would be set up as far as possible in a life-like manner all the pests destructive to forests ; examples showing the method in which the damage is done would be shown with the specimens themselves. When the animals themselves are very small, enlarged drawings would be shown alongside in order that the student might make himself acquainted with the aspect of the particular pest. The best Museum we know of this nature is Dr. Pauley's Zoological Museum at the Forest branch of the Munich University.

7. *Chemistry and Soils and Rocks.*

A representative collection of the various soils of the country would be shown in small tin boxes arranged in sloping desk cases. Above each soil would be exhibited in a glass picture frame a dried mounted specimen of the plant or plants most characteristic of that soil. A collection of characteristic rocks would also be shown here. In the best German Schools the apparatus used for soil analysis is also exhibited, and the students are shown how a soil analysis is carried out.

8 *Geology Mineralogy and Fossils.*

Collections of the various minerals, precious stones, ores and fossils are shown in this Museum.

9. *Surveying.*

A collection of all the surveying instruments used in the surveying course given to the students is kept in a separate Museum to which they have access in order that they may make themselves thoroughly acquainted with these necessary adjuncts to their work.

10. *Physics.*

All the physical apparatus used in the lectures is kept in the Physical Museum or Laboratory as it is usually called.

Museums on some such lines as laid down above will prove of the greatest service to professor and student alike, and their

formation and upkeep is a first desideratum of our Forestry College. The tending and upkeep of some of them becomes a serious consideration. Additions are constantly coming in and require to be set up, specimens require renewing, and there is a large amount of supervision constantly necessary. This is the work which falls to the assistants in the German and Russian institutions, and it is the absence of such assistants which has resulted in the Nancy Forest School Museums falling behind the high standard maintained by the others. At our British Imperial Forest Schools we would like to see this question of proper museums taken up in a thoroughly efficient manner. Owing to a false economy in past days they are admittedly far below the standard we have given above for our ideal College, and this ideal is by no means unattainable as is demonstrated by the continental Schools.

THE DIRECTOR'S, PROFESSORS' AND ASSISTANTS' ROOMS.

In addition to the rooms set apart in our main building for the Director and his assistants or clerical staff, the continental Schools recognise that each professor requires a separate working room in which he can prepare his lectures, keep his more valuable specimens, his special library and carry on his researches out of actual lecture hours. This room should, if possible, form one of the general suite devoted to his own branch of instruction, and would communicate with his assistant's room should he be provided with one.

As an illustration of the above remarks we may describe here the suite of rooms devoted to Botany at the Munich Forest College. Two rooms are devoted to Plant and Tree diseases, the collection being a complete European one. A third room contains a series of exhibits of the seeds and fruits of plants arranged in glass cases, also a set of fibres. A fourth small room contains a large series of portions of branches and stems of trees showing the results of lightning strokes and the effects of electricity on the wood. This has been arranged by Prof. Tubeuf himself, who is making a speciality of this study. A fifth room contains a collection of the woods of forest trees, the specimens being used to illustrate the botanical lectures. This series of rooms forms the Museum proper. We then come to a magnificent botanical laboratory containing

every facility for study and research. This contains a collection of tree fungi in spirit in a glass case, the herbarium and a number of other objects on which research is proceeding. The laboratory opens out into a conservatory, where various experiments in connection with growth were being carried out at the time of our visit. Students who show promise are encouraged to work in the laboratory. Next to this latter are the professor's and assistants' rooms, both well fitted with appliances, the former with a good botanical library. Beyond these again is a fine lecture hall. This latter is confined entirely to the botanical lectures, the walls being hung with diagrams of dissections of plants, picture frames containing young dried plants with their root system attached, etc. In addition there is a workshop room for packing and unpacking specimens sent out and received from the forests, and finally a dark room for photographic work. This completes as fine a series of rooms devoted to one important branch as can be desired. Above in the same building is another series, no whit inferior, devoted to Zoology.

STUDENTS' WORKING ROOMS.

Since the lecture halls are each reserved for special branches of the course, and are therefore not available for the students' use save during lecture hours, it is necessary to provide the latter with rooms in which they may study at hours when it is not convenient to them to retire to their private quarters. For this purpose we would set apart special working rooms in the main building, one being confined to each 'year' or promotion of the students. Whilst such rooms will prove of great benefit to the students themselves, they are also of use to the professors, who are able to set up or hang up specimens or diagrams which they have been exhibiting in the lecture rooms. These are changed at intervals as the lectures demand, and in this way the student has constantly before him exhibits bearing upon the subjects he is reading about at the time. A simple wall rack will enable dried specimens of plants or diagrams to be slipped in and locked in in safety, whilst a sloping desk rack enables cabinet drawers to be slipped in and exposed in a similar manner without danger to the specimens.

By the provision of students' common working rooms a privacy is guaranteed which cannot be obtained in the public lecture rooms, these latter becoming little better than lounging places or passages if used for this purpose.

Our College would of course require the usual bursar, store-keeper and curator, porters, etc.

Leaving the College building, we now come to a consideration of what is required for the practical demonstration work in the field, which forms so essential a supplement to the theoretical work in the lecture room.

THE COLLEGE GARDENS.

As an example of what a Forest College Garden should be we cannot do better than instance Tharandt. Situated on the side of a steepish hill several acres are devoted to the growth of trees, indigenous and exotic, shrubs and herbs. The garden is so planted that the species are more or less arranged in their natural orders in the beds, and in addition to containing all the cultivated herbs and perennials, areas are allowed to run wild and fill themselves up with wild flowers and weeds. Every tree, shrub and plant is named, its order, Latin and popular names being attached to the label. Here the student may come and study pure Botany as taught by his botanical professor or follow the forest lecture course of forest botany with ease and profit. The greatest trouble has been taken to introduce exotic trees, with the result that a very fair knowledge may be obtained of trees other than the ones belonging to his native country. Such a garden requires constant attendance and constant additions, and in it the student should be, and is, allowed to roam at will. In addition to the botanical garden and arboretum space is also devoted to a forest nursery in which young trees of many varied species are reared. In this the student is shown, and can study for himself, exactly how the young trees, which are at a future date planted out in the forest, are grown. The forest nursery forms an important part of the forest garden.

THE COLLEGE FORESTS.

We hold the opinion that to every Forestry College some

Large Birch Trees in the grounds of the Imperial College of Forestry, St. Petersburg.

forest areas should be attached for instructional purposes. This is usually the case on the continent, and as instances we may quote the Tharandt and St. Petersburg College Forests. In each case considerable areas are attached to the institutions and they are placed entirely under the Director of the College. Although a satisfactory revenue is obtained from these forests, this latter is entirely subordinated to the chief object for which they are kept up, *i.e.*, that of forming instructional centres for the use of the students. Perhaps nowhere can such forests be seen to better advantage than in Tharandt, where considerable sums of money have been spent with the sole object of providing the best possible training ground for the embryo Forest Officer. They have here ideal students' forests, abounding with almost every species which grows in North Europe. The College forests should be managed by departmental officers directly subordinate to the Director.

These College Forests, however, are not sufficient in themselves for the instruction of the students. For their longer tours and final practical course a further set of forest areas should be carefully chosen, and for this purpose we think the Russian plan has much to recommend it. M. E. Kern, the gifted Director of the St. Petersburg Forest Institute, has adopted the following plan: One hundred and fifty forests were carefully selected from the great forest areas of the country as affording special advantages for training purposes. Only fifty of these forests are visited in any one year, and this procedure minimises the extra work and trouble which the advent of forest students into a division must inevitably throw upon the divisional staff, since the invasion only occurs once in three years. Of course, the staff in charge of these forest areas are in no way subordinate to the Director. A further improvement of Director Kern's is that the students work in the forests in pairs from the very outset. Throughout the whole of their four years' course they are never taken about in bands. The great advantage of this plan will be obvious to all who have had practical experience of how much is assimilated during the tours conducted on the 'troop' system.

SCIENTIFIC PAPERS.

THE INSECT PESTS OF SWIETENIA MACROPHYLLA.

BY P. M. LUSHINGTON, I. F. S.

THE growth of Swietenia Macrophylla in Nilambar is so remarkably rapid that, were it not for its numerous enemies, its introduction would be an undoubted success. There is only one really big tree which is found in the middle of teak planted in 1872, which has a girth of 82 inches and a height of 95 feet, but there are many trees of good growth, notably some of 12 years old, which have reached a girth of between 5 and 6 feet and which are yielding good seed. Unfortunately, in its early years, the spotted deer browse down any seedling of this species that they can find, whilst the sambhar pick it out as a suitable tree on which to rub their antlers. Protection against enemies of this nature is however not difficult, and though this considerably adds to the expense of introduction, yet it is effective. It is, however, almost impossible to protect it against insects, whose injuries to the tree have to be seen to be believed. Not only do these insects kill off the younger plants, but I have seen well-established trees of 4 feet in girth completely killed by them, whilst even in bigger trees large branches are killed out. A study of these insects seems therefore very desirable, and anything in the way of identification may lead to a possible means of extermination. Defoliation of the young plants is fairly common, and the cause seems to be a buprestid beetle, which I have found in great numbers. Specimens of these are being identified by the Government Entomologist. More serious damage seems to be done by an insect which I have been unable to discover. This attacks the leaves, but more especially the midrib and sometimes the young shoot. The parts attacked turn brown and on the midrib and shoots a scar is left, and the woody portions become subsequently affected. I am inclined to suspect that this damage is done by a small beetle allied to the Rose beetle, for, though I have never found this on the mahogany, it is plentiful

on the neighbouring blackwood trees, where it damages the flowers and flower-stalks in a similar manner. I notice that it emits a black fluid, which appears to be injurious to the leaves. Far more serious is the damage to the leaf-buds. The leaf-bud is completely eaten away, and the insect then appears to tunnel into the twig. Innumerable instances of this kind of damage are to be found, but none of them of recent origin. From the damage done, which is exactly that described by T. S. G. in the *Indian Forester* and quoted by Mr. Stebbing on page 123 of his "Injurious Insects," I am inclined to suspect the *Magiria* (*Hypsisyla*) *robusta** as the cause; more especially as I see that damage to mahogany by this insect has been reported from Nilambar. Apart from these, however, there is a serious attack going on now which is evidenced by the leaves dying off suddenly on considerable-sized twigs. This damage is not due to any of the insects noted above, but a careful search has revealed three species of Bostrychid beetle. Of these by far the worst is a small brown Bostrychid, which enters the twig at intervals of two or three inches apart; a deep tunnel is then grooved out all round the outer part of the twig, which is almost invariably lined with a white substance. This girdling of the twig, inside the bark, appears to make the woody portion of the twig accessible, for the subsequent tunnellings are made into the wood itself, and the eggs deposited in them, and these galleries are also lined with a white substance. This appears to be nutritious, because when the young are hatched it seems gradually to disappear. The young consume the wood in all directions and render the twig quite hollow, and when they have left, these hollowed-out twigs afford refuge to ants, small bees and a variety of insects. I specially noticed one large tree which had not less than fifty twigs killed off in this manner and a few fair-sized branches. The beetle itself is very minute, not more than $\frac{1}{12}$th of an inch in length. Very similar damage is done by a larger black Bostrychid, whose borings are fairly numerous and also white-lined, but I have only found one specimen of the perfect insect and one specimen of

* In a subsequent letter Mr. Lushington informs us that he has procured specimens of this insect and was able to identify it as being the pest.—HON. ED.

what I believe to be its larval form. The third species is another minute black Bostrychid which seems to work in conjunction with the brown one. It is very numerous, but does not seem to have the power of girdling which the brown one possesses and penetrates directly into the wood. Its galleries are not lined, and I believe the damage done by it would be insignificant but for its habit of working in conjunction with the brown species. Altogether this tree seems to be a perfect repository for insects, and, being a valuable one, seems to demand the attention of the Forest Entomologist.

Having recently received specimens of the insects alluded to by Mr. P. M. Lushington in the above paper I have been able to make a few preliminary identifications and observations upon them :—

The Buprestid beetle is *Psiloptera fastuosa*. This insect has been previously reported from Nilambar as injuring the teak plantations by boring into the wood, presumably in its larval state (*vide* 'Injurious Insects,' p. 39). Should Mr. Lushington be able to corroborate this observation it will tend to prove that the planting of mahogany with teak is directly in favour of the beetle.

The beetle considered as allied to the Rose beetle, and reported as damaging the flowers and flower-stalks of the Rose wood (*Dalbergia latifolia*) is a species belonging to the genus *Serica*. Several other species of this genus are now known to commit damage in this way, and it is probably one of considerable economic importance in India It is not at all unlikely that the species here alluded to also attacks the mahogany, and it will prove of interest if Mr. Lushington can prove that this is the case.

The life-history of the tún borer (*Hypsisyla robusta*), as far as it is at present known, is described in Departmental Notes on Insects that Affect Forestry, No. 2, p. 312.

The beetles alluded to as Bostrychids are three species of the bark and wood-boring family of *Scolytidæ*. The small brown one girdling the twigs is a species of *Xyleborus* or a closely allied genus. The damage done by this pest appears to be very considerable.

The large black insect is a species belonging to a genus about which little is known in India. The larva supposed to belong to this insect, belongs to quite a different family, the true Bostrychids, *Bostrychidæ* (for the difference *vide* Vol. XXIX, No. 1, 2, of this Magazine), it being provided with three pairs of legs, one pair on each of the three segments following the head. This larva may prove to be that of a species of *Sinoxylon*.

The third beetle mentioned is probably a species of *Tomicus*, a wood-eating genus of the *Scolytidæ*.

Mr. Lushington's note is a most valuable one, and I trust he will continue his observations. During ten days spent at Nilambar towards the end of August 1902 I found a grub of a weevil boring galleries in the succulent bark of the mahogany trees in the Aravallikavu Plantation. These galleries penetrated down to the sap wood. One two or more galleries take off from an irregular shaped central chamber,

The attack can be recognised externally by a flow of gummy matter which exudes from the attacked area and drips down the outer bark, coagulating in irregular-shaped sticky masses. These evidences of the presence of the grubs in some numbers were visible upon the main stems and also on the larger branches. I procured some specimens of the grubs and pieces of bark, but the latter dried up and the former consequently died before pupating, ; the mature insect has not yet been procured.

In addition to the attacks of the larva of the moth *Zeuzera coffeæ* (*vide* 'Injurious Insects') young saplings also have to fear those, which are probably by far he most important, of a longicorn borer, only the grub of which is at present known. I was able to see the evidence of these attacks in the interior of the wood of some trees which were split up. It is very desirable that the life-histories of both the weevil and the longicorn borer should be worked out.

I trust to be able to furnish a further note on the *Scolytidæ* when I have more fully studied these pests. —E. P. STEBBING.

ORIGINAL ARTICLES.

JOSEPH MESSER, I. F. S.

Before these pages appear in print many of our readers will have heard of the sad death of Mr. Joseph Messer, from black-water fever, on the 25th November 1904. Taken ill on tour, he was brought back, in a very serious condition, to Katha, in Upper Burma (where he had been stationed for over seven years), and expired two days later.

Mr. Messer was thirty-five years of age and had nearly fourteen years' service, having reached Burma on the 1st of January 1891. For the first five and a half years of his career he was mostly employed on Working Plans. In July 1896 he took furlough for fifteen months, and on his return in October of the following year was gazetted to the charge of the Katha Division, and, with the exception of six months' leave in 1902, he remained in charge of this Division till his death.

When Mr. Messer first took charge of the Katha Division it had a most unenviable reputation for fever and was justly regarded as a penal settlement. Although the Division had been eleven years in existence, forest work was still in its infancy, and Mr. Messer had a wide field in which to exercise his remarkable

faculties for organisation. The northern portion of the Division has been lately formed into the Myitkyina Division, but since the separation of the latter but little has been done, so that in estimating the progress that was made under Mr. Messer's efficient administration it is only fair to take the combined figures for the two Divisons. During the seven years 1896-97 to 1903-04 the area of reserves increased from 420 to 758 square miles and the area under fire-protection from 320 acres to 554 square miles. The revenue increased from Rs. 1,39,073 to Rs. 6,15,892; the expenditure from Rs. 56,033 to Rs 1,91,918, and the surplus from Rs. 83,040 to Rs. 4,23,974. This is a splendid record for any Division, but it by no means represents the full value of Mr. Messer's fine work. He was a great believer in fire-protection, as the above figures show, and he had hoped to protect every acre of his reserves in another two years; but he also believed in creeper-cutting and works of improvement going hand in hand with fire-protection, and he expended much energy in these necessary operations. All creepers have been cut over nearly the whole area of his reserves, and works of improvement to free the young teak have been started in almost every reserve and are being pushed forward as fast as the limited staff will allow.

But it is probably in connection with the experiments for the natural regeneration of teak that Mr. Messer's name will be chiefly remembered. Full details of these have already been published, but, briefly, Mr. Messer ascertained that by merely cutting the low brushwood in the neighbourhood of seed-bearers and burning it plentiful natural regeneration was induced, and that by a further burning the second year results equal to those of a first-class taungya were obtained at a nominal cost. The full value of this discovery cannot yet be estimated, but if the simple procedure is found suitable for all classes of teak forest our expensive system of taungyas and regular plantations will be a thing of the past, and we shall obtain better and more natural results at a fraction of the cost, whilst being able to deal with far larger areas.

Mr. Messer was a most hard-working and keen Forest Officer with the soundest views on technical matters, and his death will be

a severe loss to the Department. His life's recreation was his work, and outside of this he had few interests. He understood the Burman thoroughly and could get good honest work out of the most unpromising material. He had been so long in one Division that he *knew* his men as it is given to few Forest Officers to know them; he was honoured and respected by all with whom he came in official contact and his death will be greatly felt.

Mr. Messer leaves many sincere friends to mourn his loss. His kind, sympathetic and genial nature had endeared him to them, and on all sides are heard expressions of deep regret at his sudden death.

The value of his work was recognised outside his own Department, for, on learning the sad intelligence, His Honour the Lieutenant-Governor of Burma had the following telegram despatched to the Conservator of the Circle in which Mr. Messer had been serving :—

"The Lieutenant-Governor desires me to say that he is deeply grieved to hear the sad and unexpected news of Mr. Messer's death. The Government have lost in him a very valuable Officer, who had earned for himself a high reputation and whom they can ill-spare. Sir Hugh Barnes asks that his sincere sympathy may be conveyed to Mr. Messer's family."

We can only endorse this kind and sympathetic message.

NURSERY TREATMENT OF DEODAR IN JAUNSAR.

1. *Collection of Seed.*—The seed is collected from sound, vigorous trees in October-November as soon as the cones are ripe. Fresh seed is gathered every year for sowings, as the seed rapidly goes bad and cannot be stored for more than one year.

2. *Site for Nursery.*—A. N.-E. or N.-W. aspect is preferred with a water supply near at hand. Whether watering will be necessary or not depends on the locality and season.

3. *Preparation of Seed Beds.*—The soil is thoroughly worked to a depth of about 9" and good humus soil is mixed with it. The

beds are made 2½' wide and are raised about 4" above the surrounding level of the ground.

4. *Watering.*—Watering may be necessary in the dry months preceding the rains. Water is run into trenches alongside the beds and allowed to percolate through them without flooding them.

5. *Season for Sowing.*—The best season for sowing is November-December soon after collection of the seed and just before the snow falls. Sowings may, if necessary, be made early in the spring, but they do not give such good results as the winter sowings.

6. *Method of Sowing.*—The seed is sown in rills 3" apart across the width of the beds. Where there is fear of drought, especially with spring sowings, it is an excellent plan to cover the seed beds after sowing with moss, which may be pegged down to prevent its being blown away.

7. *Treatment of Seedlings in the Nursery.*

(a.) Ordinary method.

November-December ...	... Seed is sown.
Spring (March-April) ...	... Seed germinates.
1st July (7 mos after sowing) ...	Seedlings pricked out 4" × 4" into other beds.
2nd ,, (1 yr. 7 mos. ,, ,,) ...	,, ,, ,, 6" × 6" ,, ,, ,,
3rd ,, (2 yrs. 7 mos. ,, ,,) ...	,, planted in the forest.

(b). Basket plant method.

November-December ...	... Seed is sown in nursery beds.
Spring (March April) ...	... Seed germinates.
1st July (7 mos. after sowing)	... Seedlings pricked out into baskets.
2nd ,, (1 yr. 7 mos. ,,)	.. ,, *left undisturbed in their baskets.*
3rd ,, (2 yrs. 7 mos. ,,)	... ,, planted in the forest in their baskets.

This method of using basket transplants is by far the best. The plants are usually stronger and healthier, because they have been less disturbed ; but their chief advantage lies in the fact that they can be put into the forest with the minimun risk of damaging the roots.

The baskets are made of the small hill bamboo (*Arundinaria falcata*) called locally "Ringal." They are of cylindrical shape about 9" high and 6" diameter, and cost about one rupee eight annas per 100.

Transplanting in the Forest.—Holes are dug 18″ deep by 12″ diameter at distances 4′ × 4′ from centre to centre, and the planting is done just before the rains commence. Fig. 1 illustrates this

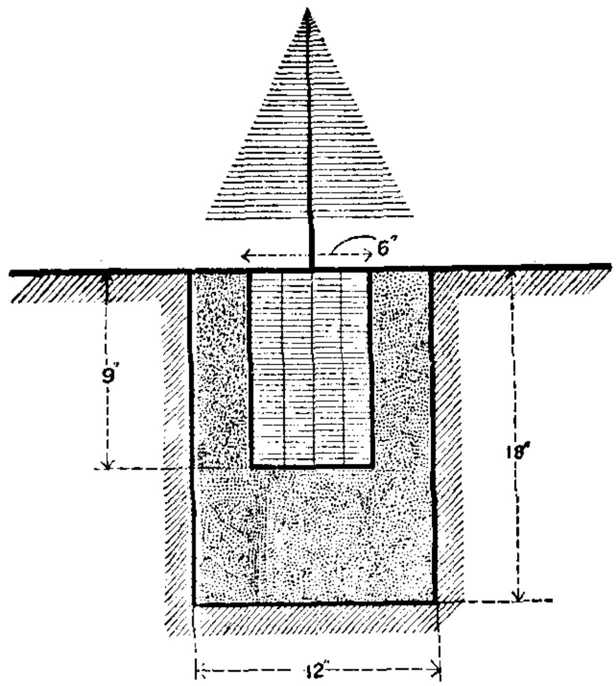


FIG. 1.—METHOD OF PLANTING OUT BASKET-TRANSPLANT.

method. N.-W. and N.-E. aspects are the best and the soil most preferred is a light rich moist one with good drainage; on hot aspects the transplants require protection.

Cost of formation of one acre of plantation at an average distance of one mile from the nursery.

		Rs.	a.	p.
Sowing and tending in the nursery for $2\frac{1}{2}$ years	... ...	3	8	5
Price of 2,822 baskets at Rs. 1-8 per 100	... ...	42	5	3
Digging holes 18″ deep × 12″ diam. at Re. 1 per 100	.. ...	55	2	10
Planting 4′ × 4′ apart at Rs. 1-15-3 per 100	... ...	28	3	6
Total	... ...	129	4	0

or approximately Rs. 130 per acre.

B. O. COVENTRY,
Deputy Conservator of Forests.

The 17th September 1904

NOTES ON THE COMMERCIAL TIMBERS OF NEW SOUTH WALES.*

From the pen of that admirable and indefatigable botanist, Mr. J. H. Maiden, we have before us the second edition of this small and highly useful illustrated work. In his introductory remarks the author gives the reasons for the appearance of the pamphlet. The object is to give information in regard to the principal commercial timbers of the Colony in language as devoid as possible of scientific technicalities. Only those points are touched upon that are of practical moment to the timber-getter, saw-miller, merchant, or user. "An endeavour has been made to give an impartial statement of the merits of our timbers as we know them at the present day. In course of time some of the estimates of the qualities of particular timbers may require to be modified, and other timbers, not at present employed, may be shown to be useful for special purposes." Having for many years been almost daily occupied in the diagnosis and critical examination of colonial timbers of all kinds, and having been a large user of many kinds of colonial timbers for miscellaneous purposes, and having visited most of the principal forests and saw-mills of the State, Mr. Maiden was in a particularly favourable position to undertake the compilation of such a handbook, and its usefulness cannot be overestimated.

After pointing out that timber is a necessity, the author mentions that the supply of good timbers is not unlimited (and

* Notes on the Commercial Timbers of New South Wales, by J. H. Maiden, F.L.S., Government Botanist and Director of the Botanic Gardens, Sydney. 2nd edition, illustrated. Sydney Government Printer. Price 1s.

this remark does not apply to New South Wales alone) and that cutting requires to be followed by replanting. As regards export Mr. Maiden considers that as the merits of their hardwoods become more fully recognised a largely increased demand may be reasonably expected to set in for them, and on this head he says that too great care cannot be exercised in seeing that timber which is sent to market, and particularly that intended for export, is not only good of its kind, but also belongs to a species of acknowledged merit. In the case of trees or timbers which bear a resemblance more or less strong to valuable timbers, the greatest care should be exercised. We cannot but think that the great backwardness that has dogged the footsteps of the Department in India in this respect has been due to laxity on this score, and a small pamphlet on the subject of our good commercial woods and those inferior ones which closely resemble them, with the differences clearly indicated, would be an incalculable boon to many a Forest Officer. To its absence one cannot but attribute, in part at any rate, the extreme reluctance of the great Departments, such as the Public Works, Military Works, Telegraph, to take any but the few well-known good woods, the woods which have been used from time immemorial by the native himself, without any attempt being made to find out whether there are not a number of others which would serve equally well for many of the purposes for which the more valuable timber is now used. We think that in this respect the European has followed far too blindly in the path trodden by the native of the country. Such works as "Gamble's Manual of Timbers" are far too large for useful and handy service in this respect, and until we have a really handy reference book it is probable that many of our timbers will remain unknown as far as all practical (*i.e.*, economical) purposes are concerned.

Mr. Maiden remarks upon the importance of felling timber at the proper season and on the still greater one of subjecting the cut wood to thorough seasoning processes before exportation, more especially if intended for the foreign market.

In Part II of the pamphlet the author deals with the classification and description of the commercial timbers. His divisions of

this part will explain themselves. They of course deal with the bark or wood of the various trees, leaving out of the question all systematic classificatory considerations. We have a first group termed Iron barks, then Stringy barks, (3) Pale hardwoods, (4) Red hardwoods, (5) Turpentine and Brush-box, (6) Cedar, Beech and Pine, (7) Silky Oak, She-oak, &c., (8) Black bean, Myall, and (9) Miscellaneous Brush Timbers. Under each short descriptions of the wood are given with the uses for which it is recommended, distribution and quantity available.

Part III treats of timbers for special purposes. This practically consists of a list of the principal native timbers classified according to their uses. For instance, under the heading Bee-boxes we find cedar and beech recommended; Boat-building—cedar; Bullock yokes—river oak, swamp oak, &c.; Carriage-building, —Red cedar, rosewood, plumwood, beech, &c.; Carving—white holly, grey myrtle, &c.; Charcoal—Murray red gum, stringy bark; Railway keys—cedar, flindosa or cudgerie; Railway sleepers—iron bark, grey gum, Murray red gum; Walking sticks—(*a*) whole plant, tea trees, dwarf palms, native cherry, oaks, (*b*) cut out of solid wood, black wood, tulip, cabbage palm, &c. The value of such a useful condensed hand list cannot be overrated.

A few notes on special uses of timber, such as the wood required for backs of hair-bushes, engraving, &c., the production of such substances as naphtha, wood-spirit and tar, mining timbers, Railway sleepers, wine casks, wood pavement and wood pulp, brings this extremely useful and handy pamphlet of 38 pages to a close. At the end are nine excellent plates showing the stems of some of the chief of the large commercial trees.

We have reviewed this small work at some length because we would draw attention to the inestimable advantage such a handbook would prove to the Indian Forest Officer, and one may include the officers of the Public Works, Military Works, Telegraphs and the great timber merchants of the country. We all require a handbook for use in the forest. Neither "Gamble's Manual of Timbers" nor "Watt's Dictionary of Economic Products" can be used as such.

SHIKAR, TRAVEL AND NATURAL HISTORY NOTES.

OUTBREAK OF A FATAL DISEASE AMONG WILD ANIMALS AND AGRICULTURAL CATTLE IN MYSORE.

Having seen an article entitled 'A New Disease in Coorg' in the *Indian Forester* of October last, I would wish to place upon record the following facts in connection with it which have come to my notice during the last four months :—

The disease was first noticed on a 'Kumki' elephant by name 'Kadampyari,' which was sent to Kymara, a forest station on the frontier line between Malabar and Mysore, for dragging timber in the forest; the elephant was at Kymara for three days, but did no work, as the forester was not present. It returned to Mastigudi on the 28th May in an apparently healthy condition and dragged timber in the Kardihalla forest for two days. On the morning of 1st June a big swelling like a bubo appeared between the hind legs, which travelled on towards the neck; the animal gave up its usual leaf fodder, but used to take in small quantities of rice, mixed with jaggery, and little or no water. The mahouts did not know what the disease was, but gave some highly stimulating medicines and also externally applied an ointment prepared of 'ragi' and a jungle root. The animal was brought to Kakankote from Mastigudi, a distance of one mile, on the first day of its illness; for three days it was ailing from this disease, falling down and getting up repeatedly, probably owing to colic, and experienced difficulty in breathing. In spite of all the medicines and treatment afforded, the animal grew worse day by day, and succumbed to the disease on the 7th idem. Instantly a big pit was dug, the carcase was dragged to the pit by other Kumkis, burnt and buried.

About the same time a petty merchant, who had gone to Malabar, returned from Vonteangadi, a Malabar village, *via* Kymara and Sunkadkatte, with four bullocks. He lost one of his bullocks

on the road, another in his village Oyyamballi from apparently the same disease as above, and the infection spread from these into the surrounding villages around Antersante, with the result that fifty cattle died in thirteen villages in all, only seven attacked animals recovering.

I heard from the Malabar Range Officer that one of the timber-dragging elephants named 'Phyllis' was attacked in Begur, a forest station seven miles from Vonteangadi, and that all the other elephants were segregated at once; the whole bubo was cut away and medicine applied, and it recovered. Many cattle in and around Vonteangadi had also succumbed to the disease.

These instances prove that the disease spread from Malabar into this part of the Mysore district.

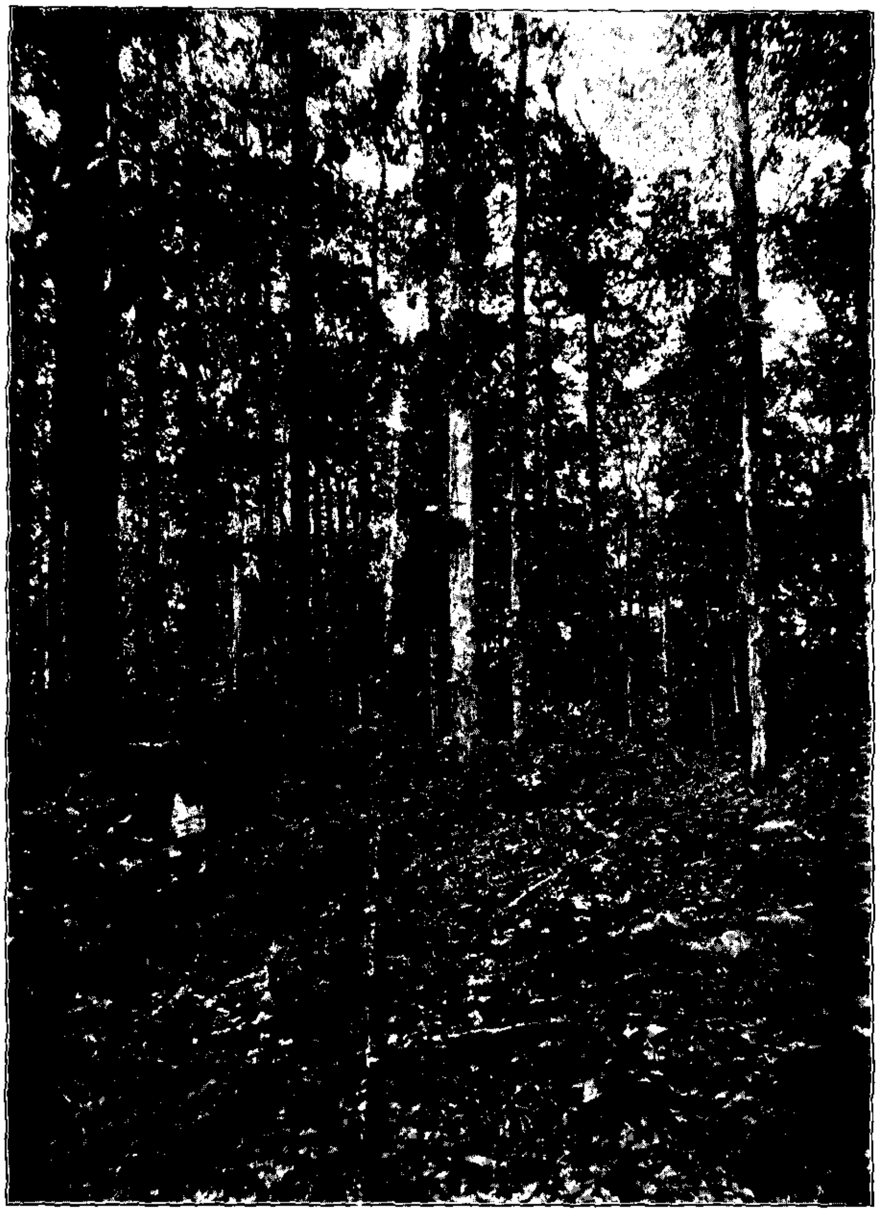
To show the further progress of the disease towards Kakankote, 'Wasp,' a well-known shikari elephant, caught the infection on the 10th; the swollen part was branded, and the animal seemed to improve, but grew worse on the 11th, and died on the 12th. The other Kumkies, *viz.*, 'Ganesh' and 'Jang Bahadur,' were segregated at once from the diseased elephant; they had, however, caught the infection, but managed to go to Karapur, a distance of six miles. Ganesh could go no further, but Jang Bahadur, continuing its journey, reached Munchagowdanhally. The former exhibited the swelling, which increased and showed the same symptoms as those of Kadampyari, and the elephant died on the 18th in spite of all the treatment afforded. Jang Bahadur had swellings all over the body, and these began to open out after the application of an ointment. The animal recovered.

The disease now spread into the jungles, with the result that six wild elephants, five male and one female, eight bison, fourteen deer, and three sambar were found dead in different parts of the forest.

The matter was reported to Government, and the Government Bacteriologist and Veterinary officers were requested to diagnose the disease. They came to Kakankote, and had two elephants exhumed, but the process of decomposition was so far advanced that nothing could be made out of them. At Antersante the blood of Jang

Bahadur, who was recovering, was examined, and it was found to contain bacilli which the Bacteriologist thought were a variety of *Bacillus septicæmia hæmorrhagica.* He says that a similar epidemic was observed among deer and cattle in 1894 in parts of Germany, but the only new feature is the attack of elephants. The measures he recommends are the isolation of the infected animals, the prevention of the healthy ones from gaining access to the contaminated places, and the burning of the carcases wherever practicable, or deep burial, so that the surface soil may not become infected.

CAMP METIKUPPE: L. P. MASCARENHAS,
16th October 1904. *Forest Ranger, Kakankote.*



Photo, A. B. Jackson.

Teak Plantation about 50 years old, Nilumbur.

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INDIAN FORESTER

MARCH, 1905.

THE STUDY OF INDIAN NATURAL HISTORY.

OUR readers will have read with the greatest interest, perhaps in some cases not unmixed with a little indignation, Mr. Gamble's letters on "Certain Important Forest Questions." It is not our purpose here to enter into a detailed criticism of the views set forth, since they will doubtless call forth the emendation or condemnation which, according to the experience of the critic may appear to him to be their due. There is a point mentioned in the second letter, however, which we are extremely glad to see brought into prominence by a man of the recognised scientific attainments possessed by Mr. Gamble, even though we are unable to accept his deductions as being at all fair to the service which he himself has helped to shed a lustre upon.

The point in question is his allusion to the duty, for we think it cannot be justly called by any other name, which falls within the sphere of Forest Officers (we would rather say of the Forest Department) of adding to the total of our knowledge of the science of Natural History in India. In the article published last month we read —

"And here I should like to point out what a magnificent field the more out of the way forests of India still offer to those who can add something, however small, to the sum of our knowledge of Indian Natural History; for nobody in India has such facilities for doing it as Forest Officers have. The Forest Department has already a considerable roll of fame, both in botany and zoology; but India as yet is only imperfectly explored, and though I know that several Forest Officers are at present doing a great deal, I think there must be others who can help as well in camp, without

very great interference with other duties. It is a common and very true saying that every forester is a student all his life; that to those who observe new ideas come every day, and observation of the natural objects of the forests is surely a part, and a very important part, of the study, and may also help to relieve the tedium of many a long and often otherwise uninteresting march. My idea of what the Forest Department should be in India is perhaps Utopian, but it is at any rate a high one. Except the Geological and Botanical Surveys, which are quite small and special, it is the only Government agency in India which has to deal with natural history, and I have in my mind the Forest Department as the *pioneer of scientific work*."

We may preface our remarks by saying that we agree with Mr. Gamble in every line of the above extract, but we do not agree with the spirit in which the words were penned, nor can we believe that, were he even remotely acquainted with what the work of a divisional officer in charge of a big division is now-a-days, they would ever have been written. The paragraph is intended to point his argument that although botany was well taught at Cooper's Hill it was doubtful (to him) "whether it has always been quite the right sort of botany that is wanted for our purpose," and further "although Professor Marshall Ward is one of the highest authorities on fungoid diseases of trees and must have taught about them to some extent, but one of his old pupils, so far as I know, has yet attempted to pursue the subject in India, and yet it is a subject of quite as much importance as is that of noxious insects." Perhaps Mr. Gamble is not quite in a position to make this latter statement, but we may let that pass. We will admit that he is quite correct in both his contentions. The subject *was* taught by Professor Marshall Ward, and it *is* an extremely important one, but can he really consider that he is fair in attributing blame to the Department as a whole, and to one set of Forest Officers in particular, to wit Marshall Ward's old students, when he animadverts to the fact that these latter have not become specialists in fungoid tree diseases. Has Mr. Gamble consulted a list of Forest Officers and endeavoured to make himself acquainted

with the extent of the charges held by the majority of the Professor's old pupils, and does he realize what the administrative and professional duties of these divisions now entail? What is the daily life during the camping season some seven months in the year) such a charge necessitates? Between 4—6 hours of hard physical and mental strain in the jungle followed by several hours office work on return to the rest-house or tent, and this day after day, week in and week out, with scarce the remembrance that there is such a thing as a seventh day, the day of rest in the week. We do not write this in any grumbling spirit. The work is intensely interesting and becomes absorbing, but scant time does it allow for dabbling, even fitfully, and therefore unprofitably, in a subject which particularly requires the knowledge of the specialist; those rare exceptions where a superabundant energy happens to be combined with a very sound constitution, enabling the day's work to be extended beyond the length nature has ordained, may well be left out of consideration in the present article. But whilst we think that our criticiser's strictures are, considering the heavy charges and the present undermanned state of the Department, unfair, not to say ludicrous, we welcome the note that has been struck, since it coincides with a doctrine which we have been striving, all to inadequately, to inculcate. We do not consider Mr. Gamble's ideas on the subject of the scientific research work the Department should do and the scientific position it should hold in the least degree Utopian. We would go further and say that we hope to see the service something more than a pioneer in scientific work; we hope to see it in the foremost place amongst the well-established leaders of such work, and our hopes are all the stronger in that it is becoming daily increasingly evident that such work will prove of the greatest use economically to the Department. Work done by the scientist, or specialist as he should more properly be designated, in such a service as the forests means economic progress and research, both of which spell, as the world now-a-days is fully aware, a steady increase in the financial prosperity of commercial concerns. But this cannot be brought about under existing conditions nor by the ineffective dabblings of already

overburdened executive officers. The days when the two could be successfully combined are gone never to return.

We will turn and consider for a moment how it is that Germany, that Russia and, finally, that latest recruit, America, have done and are doing so much to bring up to date and enlarge their knowledge of the scientific natural history, or what is of more importance since the former must naturally precede the latter, the economic natural history of their several countries. We would ask has this been done by the men who are responsible for the carrying out of the executive duties which have to be put through and kept up to date? We think Mr. Gamble will agree with us that it has not. In all commercial concerns which come to the front in these days of competition, in all Government Departments in which the management and work have been brought into line with present day requirements, it is the inclusion of the specialist to assist the executive staff that has enabled this to become possible. If we glance through the Continental Services and Schools of Forestry we find the specialist at work assisting the executive officer in all questions concerning botany, zoology, chemistry; we see, as has been shown in a previous article, promising students in the Schools assisted and encouraged to go through additional courses in the subject in which they have shown a special aptitude; the idea being that the special knowledge so acquired will enable them to prove of greater use to their several Governments when they finally join the Service.

Can Mr. Gamble furnish us with the name of any of Professor Marshall Ward's students who were given such special advantages whilst at College. We could give him the names of several men who would have followed such a course gladly and would have doubtless done excellent work in India as a result of it, given the opportunities their more lucky confrères on the Continent obtain.

The allusion to the magnificent field offered by out-of-the-way forests for adding to our knowledge of natural history is doubtless intended in a botanical sense. Zoologically speaking the remark equally applies to the most accessible wooded or even unwooded areas of the country. Although almost incredible, it is a fact that

there has been scarcely a scientific Zoological expedition of any note to India as a whole since the British came to the country. Remote inaccessible spots have been visited and their fauna collected, but India has been left severely alone. The consequence is that, with the exception of a few groups, the smaller forms of zoological life are almost unknown, and amongst them those appertaining to the forests hold a very large place. Can the *Forest Officer* be blamed? The major portion of the little that is known is due to him, collected whilst engaged in his ordinary executive work; but this is not the way to make true progress either zoologically, botanically or chemically. To really advance the specialist is required in all these subjects.

We have alluded to the training of the recruits of the Department. We are now standing upon the threshold of a new departure, and we would suggest that, if it is found at all feasible, *some of the great facilities for research work within* the reach of the German, the Russian, the American, etc., forest student should be placed within that of the recruits for the controlling staff of the Indian Service. Further, that promising students should be encouraged by being allowed to spend an additional year or two on deputation at Home with a view to their going through extra courses in subjects which are known to be of the highest economic importance in India. We venture to predict that should such a course commend *itself* to the authorities, not only will the stigma which Mr. Gamble attaches, we think unwarrantably, to the Department be removed but our knowledge of the natural history of India, and of the Indian Forest in particular, will soon be greatly augmented, and with this augmentation will follow, as a natural result, the application of this knowledge to economic ends.

SCIENTIFIC PAPERS.

ON THE TWO SPECIES OF BLACKWOOD FOUND IN SOUTHERN INDIA.

By T. F. Bourdillon, F.L.S.

When Col. Beddome was writing his description of *Dalbergia latifolia* for his 'Flora Sylvatica' some thirty years ago, he made the following remarks:—

"The *Dalbergia sissoides* (Graham), common about the forests of the Coimbatore district, Palghat, the Anamallays, Madura and Tinnevelly, is a smaller tree than *D. latifolia*. The wood is generally of a redder colour, and the tree flowers in the rainy season (July), instead of the hot weather: it is always distinguished by the Palghat axemen as the Eeruputu, *D. latifolia* being called Eetee (Dr. Wight transposed these native names). I cannot however distinguish the two trees botanically; the flowers of the *sissoides* are said to be rather larger and the leaves narrower, but these differences are not constant, and the same drawing might answer for either tree; I cannot therefore look upon *sissoides* as more than a variety of *latifolia*."

This view was accepted for a long time, and all specimens of blackwood from Southern India were labelled *D. latifolia*. Later writers, however, have expressed the opinion that the two were different species, though the difficulty has always been to describe their points of difference. Thus Mr. Gamble in his 'Manual of Indian Timbers' at page 252 says: "The specimen, No. W. 3851, is probably *D. latifolia* var. *sissoides*, which seems to deserve specific rank." Again, Major Prain in his monograph on the species of Dalbergia, page 82, writes of *sissoides*: "This species is very nearly related to *D. latifolia*, and may indeed be only a form of that tree; the distinctions, however, seem constant so far as India is concerned, and the wood-cutters of Southern India are said to distinguish the two by their habit and their timber, and

to give them different names." Sir D. Brandis holds the same view.

Some months ago Major Prain asked me to ascertain if *D. latifolia* really occurred in Travancore, as all the specimens sent to him and labelled *latifolia* had turned out to be those of *sissoides*, and since that time I have been making enquiries in different quarters as to the existence of both species or of only one. I soon ascertained that there was a complete unanimity among all carpenters and timbermen that there were two different woods known as "eetti," and further, the samples brought to me invariably showed the same differences, and could always be distinguished. They are known as "kár-eetti" or dark black wood, and "vell-eetti," or pale black wood, and the common vernacular names for both are in Tamil "thothagatti" and in Malayalam "eetti" and "veetti."

Having satisfied Major Prain that D. latifolia does occur in Travancore, the next point to be determined was which of the two kinds of wood was to be referred to *latifolia* and which to *sissoides*. I was also anxious to discover if the two species could be early distinguished when growing in the forest, for Herbarium specimens are not always easy to separate.

Further enquiries and examination of trees cut for the purpose showed that the darker wood or "kar-eetti" is *D. latifolia*, and the paler or "vell-eetti" is *D. sissoides*. I also ascertained that when in young leaf the trees can be easily distinguished, even at the distance of a quarter of a mile; but when in mature leaf, they are not so distinguishable, although they can always be separated without difficulty. I will now give in detail the differences between these species.

General appearance.—*D. latifolia* attains a larger size, its foliage is more compact and always a dark blackish-green, whereas the foliage of *D. sissoides* is at first bright grass-green, and even when mature it is never so dark as the other.

Foliage.—In *D. latifolia* the number of leaflets is 3—7, generally 5, and the length of the rachis is 3-4, but rarely 5 inches. In *D. sissoides* the leaflets number 5—10, generally 7, and the rachis is 5-6 inches long. In *D. latifolia* the petiolules are very short

and slender (under ¼ inch) and the leaflets are round, obtuse or emarginate, the outermost being the largest, and the others decreasing in size inward. In *D. sissoides* the petiolules are longer (from ¼—⅓ inch) and stouter. The leaflets are pointed at both ends and are all of the same size or nearly so. The young leaves of *D. latifolia* are very dark-green, and the mature leaves are black-green above and glaucous beneath and somewhat thin, but the young leaves of *D. sissoides* are very bright-green, and the mature leaves are a lighter-green above and paler beneath, thicker and more glabrous than those of the other species.

Inflorescence.— The flowers of *D. latifolia* are arranged in lateral panicles, axillary or from the axils of fallen leaves, and rarely terminal. Those of *D. sissoides* are terminal and are slightly larger. In other respects they are similar. Both trees flower in January-February.

Fruit.—Major Prain notes that the fruit of *D. sissoides* is narrower and at the apex less rounded than in *D. latifolia.* Further, the apex of the fruit in *D. sissoides* appears to end in a bristle which is absent from *D. latifolia* (*vide* Plates 62-63 of Vol. X of the 'Annals of the Royal Botanic Gardens,' Calcutta).

Timber.—The ground-colour of both woods is purple, but whereas that of *D. latifolia* is uniform in colour or is veined with black or red lines, and in some cases is a beautiful lake (whence no doubt the name of Rosewood) the wood of *D. sissoides.* is much mixed with dark-brown and never has any tint of red in it. Some samples resemble walnut or one of the *Albizzias.*

The best way of identifying the species is to split a piece of the wood, when the red or brown tint will at once be seen mixed with the purple. Carpenters state that the wood of *D. sissoides* is harder, heavier, coarser, and does not take such a good polish as that of *D. latifolia.* My experiments with *D. sissoides* give W = 52lbs. P = 721.

I have not experimented with *D. latifolia*, but Mr. Gamble takes as an average (quoting Sir D. Brandis) W = 50lbs. P = 950, but says that the latter figure is too high. Probably there is not much difference in their weight and strength.

Photo, A. B. Jackson.

Two-year old Teak Plantation, Nilumbur.

Both timbers sell for about the same price, but most people prefer *D. latifolia.*

Habitat.—Speaking generally, it may be said that *D. latifolia* prefers the interior forests and *D. sissoides* the outer-hill slopes; in fact they are known in some parts of the country as "Ulmalei" or blackwood of the inner-hills, and "Poromalei" or blackwood of the outer-hills. The former ascends the hills to a greater height, but I have seen *sissoides* at 2,000 feet. At the lower elevations *sissoides* predominates, but *latifolia* is also found, and from the abundance of small plants of this species it may be inferred that it was at one time more common in easily accessible parts than it is now.

Now that these trees have been separated as true species, it would be convenient to give them different English names. *D. latifolia* is generally known as "Bombay rosewood." For *D. sissoides* I would suggest the name of "Malabar blackwood."

ORIGINAL ARTICLES.

THE NILAMBUR TEAK PLANTATIONS.

BY R. McINTOSH, M.A., I.F.S.

On the west coast of Madras and lying to the north of Travancore and Cochin States is situated the district of Malabar, the home of the Naiar and the Moplah, and the scene in former days of many a struggle for supremacy between the British troops and the invaders from Mysore under Tippu and Hyder Ali. Seringapatam settled the fate of Malabar, and now all is peace except on the rare occasions when a band of Moplah fanatics "goes out" and, after a brief space of defiance, meets its inevitable fate at the hands of a few British troops.

Nilambur is a small village situated some 45 miles from the coast up the Beypore river, and lying close to the foot of the Neilgherry Mountains. The Nilambur Valley is described in the district manual as being of the shape of a horse-shoe,

surrounded on three sides by hills which rise on the north-west to 8,000 feet, while those on the north-east obtain an elevation of some 3,000 feet and lead on to the Wynaad plateau. In the semi-circle of these overhanging hills lies Nilambur, situated about 400 feet above sea level, with a rainfall which averages 120 inches and a temperature in the shade ranging between 80 and 90 degrees the whole year round. The soil of the valley is mainly an alluvial deposit, often of enormous depth and broken at intervals by patches of laterite, which sometimes take the form of small detached hills.

On one of these small hills stands the District Forest Officer's residence, whence from the verandah he can overlook the river flowing past the foot of the hill and the plantations which stretch away northwards, mainly along the banks of the river and its tributary streams. Here, alone, a Forest Officer has lived for the past sixty years, shut off from society of any sort, living a monotonous and almost primitive existence, but employed in the creation of a plantation which bids fair to be one of the most successful undertakings, both pecuniarily or otherwise, on which the Forest Department in India has ever been employed.

The sole credit of originating the plantations is due to Mr. Conolly, a Collector of Malabar. As long ago as 1840 he foresaw that the teak forests of Malabar could not long withstand the demand made on them by private rapacity and public indifference, and he suggested to Government the desirability of forming teak plantations in the Nilambur Valley.

Had Mr. Conolly searched throughout the whole of India he could not, in all probability, have hit upon a spot more suitable for his purpose than this Valley. Soil, rainfall and temperature are all that could be desired. The plantations are situated on the banks of an almost ideal floating stream, which flows into the sea at Beypore, a small port much frequented by small trading vessels from the Persian Gulf and Arabian Sea. These traders eagerly compete for the produce of the plantations, shipping it to Persia and Arabia to supply the requirements of those countries, where building timber and poles for boat masts cannot be obtained.

Photo. A. B. Jackson.

Officers' Camp Rest-house, Nilumbur.

Mr. Conolly obtained the requisite permission to start the plantations. A commencement was made at once, and there are papers on record which show that in 1844 Mr. Conolly was perplexed with the difficulty of getting teak seed to germinate and the young plants to withstand transplanting. In 1844 Chattu Menon was appointed native Conservator under Mr. Conolly, and from that date until 1862 he continued in sole charge of the plantations.

Mr. Conolly remained long in Malabar, and ultimately came to an untimely end in September 1855, when one evening, whilst sitting out in the verandah with his wife, he was attacked by three Moplahs and hacked to pieces in her presence.

Much of the land in Nilambur Valley is private property, but it fortunately happened that in 1840 one of the numerous landowning temples required ready money, and a considerable area of highly suitable land was obtained by Government on payment of a lump sum down and a royalty on every teak tree grown on the area. Subsequently Government were able to obtain further areas either on similar terms or by purchase, and the Department now possesses suitable lands amply sufficient for planting purposes.

Chattu Menon soon overcame the difficulty experienced in getting the seed to germinate, and the method adopted by him is, with a few minor modifications, retained to this day. The seed is collected in February, and sown early in April, after having been soaked for forty-eight hours in water. In sowing the seeds are covered to a depth of about ¾ inch with fine soil. On this a few small twigs are placed and on the top a layer of straw to retain the moisture. After copious watering each day the seed germinates in 15 to 20 days. The young plants are watered until the setting in of the monsoon early in June, by which time they are from 4 to 8 inches high and ready to be planted out. The planting site is felled over in the cold weather, burnt over in March, and the planting pits made ready for the planting out which is to commence in June.

From the commencement, on an average, 100 acres have been planted up each year. The work was stopped for some years

when a Conservator took a pessimistic view of the operations, but fortunately wiser opinions subsequently prevailed, and the planted area at the end of 1904 amounted to 5,378 acres.

Much credit is due to Chattu Menon for his work at Nilambur. With the exception of attempting to plant teak on the laterite areas and not realising the importance of early thinnings in his plantations he hardly made a mistake.

With the advent in 1862 of Mr. Ferguson, a Scotch gardener imported for the purpose, planting went on apace. He soon realised the vital importance of regular weedings and adequate thinnings. He prescribed four weedings in the first two years, three in the next three years, and two for the sixth year. These weedings have since been reduced to three in the first two years and two subsequently, with a weeding in the older plantations once in every five years.

Mr. Ferguson remained at Nilambur until 1883, when he was succeeded by Mr. Hadfield, who left the plantations as recently as 1894.

In 1885 a scheme was drawn up for the conduct of the thinnings, and in 1891 this was revised. In 1895 Mr. P. M. Lushington drew up the first working plan for the plantations. It covered a period of ten years, and is now in course of revision by the same officer.

Under the working plan it is proposed to treat the plantations under the system of high forest with a clean felling of the final crop followed by artificial regeneration. On first class soils the final crop should consist of forty trees per acre and on second class soils not less than fifty trees per acre. The original planting was $6\frac{1}{2}' \times 6\frac{1}{2}'$, *i.e.*, 1,040 plants per acre. It is estimated that the age at which trees on first class soils will become exploitable, that is to say, will measure 6' 6" in girth, will be 95 years and on second class soils 140 years. The final fellings will be spread over a period of fifty years, and are estimated to yield annually 148,000 cubic feet of first class and 74,000 cubic feet of second class timber. This at the rate of Rs. 3 per cubic foot for first class and Rs. 2 for second class timber should provide a net

Photo, A. B. Jackson.

Views on the Beypore River, Nilumbur.

revenue of close on six lakhs per annum during the final fellings.

That the rate of growth on the better soils is marvellous, and that the exploitable age has not been underestimated, is shown by the fact that it is by no means unusual to find among the older plantations, which are now about sixty years old, trees which exceed 120 feet in height and 7 feet in girth.

It is difficult to realise that in these plantations the Madras Government possesses a property which will, unless something very untoward happens, in about 35 years from now commence to yield a net profit of some six lakhs per annum, irrespective of the revenue which will be derived from the thinnings going on in the younger plantations concurrently with the removal of the final crop.

These thinnings are in themselves of considerable importance. They yield a very large revenue, and until the time comes for the removal of the final fellings they are of primary importance. It is hoped that the revenue from the thinnings will very considerably more than cover the entire expenditure on the plantations, leaving the final crop as clear profit. Nor can it be said that this is too sanguine a view to take. The results from the commencement up to date much more than justify this estimate. From 1840 to 1904 the total receipts from the plantations have amounted to Rs. 17,41,739, while the total expenditure, including land purchase amounts, establishment and every other charge which could possibly be set against the plantations, only amounts to Rs. 15,32,308. In other words, the plantations so far *have not only paid for themselves but have in addition provided* a bonus of over two lakhs.

In arriving at the above result the question of interest has been left out of account, and consequently the figures do not show the true state of affairs.

If compound interest at 4 per cent is allowed, then the expenditure up to date amounts to Rs. 37,14,091 and the revenue to Rs. 35,31,013—that is to say, the Forest Department at the present moment is less than two lakhs out of pocket over

the plantations, and as a set-off against this cash deficit has, in addition to the ownership of the land which has been acquired for the plantations, an area of over 5,300 acres stocked with teak from 60 to 1 year old, the value of which at the present moment must be, although it is not easy to estimate it, something very large indeed.

THE FORESTRY EXHIBIT AT THE BOMBAY INDUSTRIAL AND AGRICULTURAL EXHIBITION.

An Industrial and Agricultural Exhibition was held in Madras last year simultaneously with the meeting of the National Congress there, and this year a similar exhibition has been held in Bombay, but on a much larger scale. A not unimportant part of the collections was the Forestry Exhibit, and we propose to give here a brief description of its more important features.

The Forestry Section was divided into three groups: (*a*) Economic Products; (*b*) Timbers; (*c*) Miscellaneous. These groups were shown in sheds with sloping roofs made of bamboo framework, covered with canvas and lined inside with white cotton sheeting. The western and northern portions of the sheds were enclosed by walls lined also with white cotton sheeting. These walls, which were about 8′ 4″ high, extended almost up to the roof, leaving a space of about 1 ½′ for ventilation. The Economic group was 69′ × 33′ and the other two were 37′ and 33′ × 30′ respectively.

In the centre of the Economic group was a wooden structure 3′ × 12′ surrounded by a rope railing consisting of tiers of shelves rising on either side and culminating in a top ledge 3′ broad. Arranged on the tiers of this structure, were economic products of all descriptions, consisting of roots, tubers, leaves, fruits, seeds, barks, fibres, gums, resins, oils, honey, rubbers, lac (in all its stages), specimens of water-yielding plants, articles of bamboo manufacture, native musical instruments, made of various woods, etc. It would occupy too much space to describe in detail the various exhibits under the above heads, but it may be of interest to touch upon a few of the more prominent ones.

Roots and Tubers.—Among these the roots of Pogosternon plecthranthoides and Plumbago zeylanica are the most interesting. The juice of the former is utilised in snake bite and is alleged to be a specific in such cases as is the latter in plague. The juice of the roots is apparently rubbed on the swellings which occur in plague and effectively burns them out. The wild yams are represented by large specimens of Dioscorea bulbifera, D. pentaphylla, D. dæmona and others, and by interesting specimens of the tuberous root stock and sheathing leaf stocks of the wild plantain (Musa superba), which are of considerable economic value according to a paper read by Mr. Ryan recently before the Bombay Natural History Society, and published in the Society's 'Journal,' Vol. XV, page 586.

Rubbers.—Good specimens of Ficus elastica and Hevea braziliensis have been supplied by Lieut.-Col. Wyllie, Cantonment Magistrate of Belgaum, well known as the originator of certain large rubber plantations in Burma. Professor Gammie, of the College of Science, Poona, also supplied a specimen of rubber obtained from Oryptostezia glandiflora, a climber which is said to be spreading about gardens in the Konkan. Professor Gammie, it may be mentioned here, also supplied some excellent herbarium specimens of well-known forest trees for exhibition as well as photographs of the same.

Water-yielding Plants.—These included wood specimens of and liquid from Calycopteris floribunda, Vitis adnata and Ficus glomerata, and liquid from the gram plant (Cicer arietinum) and Sugarcane (Saccharum officinarum), and Cocoanut (Cocos nucifera).

Copy of a paper recently read before the Bombay Natural History Society on the water-yielding properties of Calycopteris floribunda accompanies the wood specimens of the plant on exhibit, together with a large photograph of the climber as seen in the Thana Forests. It appears that a sample of the liquid from the stems of this plant was analysed by the Bombay Municipal Analyst, through the courtesy of Mr. Hervey, C. I. E., Municipal Commissioner, Bombay, and that it was declared fit for drinking purposes. In addition to its utility as a water-yielding plant it is

of considerable economic value as a spirit; also in providing material for what is known as tahal for rab in the Konkan. The climber is difficult to eradicate, for, in addition to its coppicing well, it also reproduces itself by root-suckers and by means of its stoloniferous branches.

Ficus glomerata yields a reddish fluid from the roots by incisions made in them, and as much as a quart can be obtained in a night. This is used medicinally as a cooling draught after measles and small-pox especially.

In the case of the gram and sugarcane the liquid is gathered from the leaves, and the note accompanying the former is as follows: "A piece of cloth is tied to a long pole in the form of a flag, and this in the early morning is swept over the field of gram, whose leaves are all bedecked with dew. The moisture thus captured is wrung out and bottled, and is used in diarrhœa, in cholera, and also in other stomach complaints.

Lac.—The exhibits under this head are especially of interest to the merchant, for they include the insect, branches covered with the lac incrustation from Sind and Guzerat, stick lac and shellac, and lacquerware from Sind. Large quantities of lac are obtainable in Sind, chiefly on the Babul (Acacia arabica) and also on Khandi (Prosopis spicigera), and in Guzerat on Butea frondosa, and other jungle wood trees.

Seeds.—The uses to which various forest seeds are applied are demonstrated in an interesting exhibition of chicks and other articles such as necklaces, curtain loops, flower vases, etc., made of seeds by the Sisters of the All Saints Home, Mazagon. Job's tears (Coix lachryma) are very prominent in the collection, and there is a very handsome door chick, exhibited with the permission of Mrs. H. S. Lawrence, made of Coix gigantea seeds and alluded to by Sir George Watt in his Note on Coix, recently published by the Government of India.

It may be mentioned in passing that the All Saints Sisters would be very grateful if seeds of a hard texture such as Elæocarpus Ganitrus and Cæsalpinia Bonducella, Mimusops Elengi, Adenanthera pavonia, etc., were supplied to them for the purposes of

their industry at Mazagon, and they will be happy to pay for any seeds sent, provided of course the cost of collection, etc., is not too heavy. At present they purchase Elæocarpus Ganitrus seeds in the Bombay bazar at about 4 annas per 100. Seeds of that giant climber Entada scandens are largely utilised by them, and will be thankfully received. This is one of those plants the seeds of which might be collected for ornamental purposes without any misgivings, for the plant is of no value except to the wild tribesman in the Konkan, who uses the bark for cordage.

The seed collection forms a very interesting feature of the Forestry Exhibit, and has attracted large numbers of visitors.

Fibres.—About thirty different fibres are exhibited, and noticeable among them is the Sisal fibre from Agave rigida together with specimens of the handsome matting made from it, and three very handsome specimens of the plant, one in the poling stage. The Rev. W. Winsor of Sirur in Poona, who is responsible for this exhibit, also shows an interesting new machine for extracting the fibre from the leaves, a patent for which has been applied for. This machine is likely to be in much demand judging by enquiries. There is little prospect, however, at present, of Sisal fibre matting competing with Coir, for the price of the former ranges from Re. 1 to Rs. 1-4 per foot against annas 6 for the latter.

Timbers.—All the best timbers exhibited are mainly from the Kanara Forests, and they include teak, black wood, Albizzia lebbek, Calophyllum tomentosum, Artocarpus hirsuta, Artocarpus Lakoocha, Alseodaphne semecarpifolia, Chickrassia tabularis, Shorea talura, Mimusops Elengi, Dysoxyllum glandulosum, Calophyllum Inophyllum, Terminalia tomentosa, Phyllanthus emblica, Stephegyne parviflora, Eugenia jambolana, Gmelina arborea, Cassia fistula, Adina cordifolia, Albizzia odoratissima, Bauhinia racemosa, Schleichera trijuga, Albizzia procera, Stereospermum xylocarpum, Pterocarpus marsupium, Anogeissus latifolia, Hopea Wightiana, Artocarpus integrifolia, Terminalia paniculata.

A good specimen of Anjan (Hardwickia binata) was sent from Khandesh and of Populus euphratica from Sind. But the

above does not exhaust the list of species exhibited. Most of the specimens are displayed in rectangular pieces, 4 feet long and from 1 foot to 2 to 4 feet wide by 1″, half being polished by Messrs. Alexander Mackenzie & Son of Bombay. Through the courtesy of the latter two very handsome pieces of Teak also are exhibited, one being a specimen of Figured Teak from the Haliyal Depôt, Kanara.

The rectangular pieces of timber bear detailed descriptions of the uses to which they are adaptable, and they are all arranged so as to facilitate inspection.

Timber in the log and blocks for street paving 9″ × 5″ × 3″, of the size used in London, were also exhibited. A note attached to the latter shows that the qualities needed for such blocks are that they should be hard but not brittle.

An interesting exhibit, priced at Rs. 250, is a collection of small blocks of timbers, representing volumes in a book shelf, bearing their scientific as well as native names. This exhibit won a prize at the Madras Exhibition last year. It was prepared by Mr. A. V. Coelho, Timber Contractor, in Kanara.

A trophy (of 31 different timbers, all from the Konkan), designed by Mr. Murzband, C.I.E., Executive Engineer (retired), stands in the form of a pyramid in the quadrangle behind the Economic and Timber Courts. Two bamboos from the Bansda State, in Guzerat, one 75 feet high, are erected close to the trophy.

Miscellaneous.—Under this head the process of charcoal manufacture, which forms an important industry in the Presidency and Sind (about 50,000 tons being manufactured annually), and an interesting hay press, erected for the first time and designed by a Parsee, Mr. Irani, Range Forest Officer, are exhibited. From the note appended to the hay press it is gathered that during the last famine (1899-1900) the Bombay Forest Department collected and pressed over 18,000 tons of grass by means of hand-presses and despatched the same to the famine-stricken areas, and that hay-pressing operations with Mr. Irani's new press are now about to be carried on in Khandesh to meet the demand for fodder in Guzerat.

Mr. Irani is to be congratulated on having invented a very useful machine, the patent for which has now been applied for.

Photographs.—Most of these, representing forest problems and operations, are the work of Messrs. Limaye and Budbudé, Rangers in the Thana District, and some have been provided by Mr. R. S. Pearson, I.F.S. An excellent series of photographs of Palms introduced into and indigenous in Bombay are exhibited by Mr. H. M. Phipson, chief of the energetic Secretaries of the Bombay Natural History Society. Three interesting photographs by Mr. E. R. Stephens, I.F.S., showing the Dehra Dun Forest School Building and Students' Quarters, kindly sent by the Director of the School, are also exhibited.

Maps, Working Plans and Forest Literature.—A map, on a scale of 48″ to 1 mile, showing the distribution of Forest lands in the Bombay Presidency, supplied under the authority of the Inspector-General of Forests and through the courtesy of the Superintendent of Forest Surveys, is on exhibition, as also a map of one Working Circle of the Forests of the Wada Range, Central Thana Division. A brief popular description in large type of the method of exploitation of the Thana Forests, which are adjacent to Bombay, accompanies this map, and below on a table are arranged printed copies of all the sanctioned Working Plans in the Presidency and Sind for the benefit of those who may wish to know more about the management of the Forests in other parts of the Presidency.

The standard works on the Forest flora of the country are also exhibited.

Two Native States, Bansda and Baroda, have included their exhibits in the Forestry Courts.

To add to the interest of the Exhibition a few representative wild tribesmen from the Konkan were brought in, and the methods by which they trap and snare birds and animals are demonstrated by themselves. This naturally has formed a very popular feature of the Exhibition. Through the courtesy of Col. Bannerman, of the Parel Research Laboratory, the various poisonous snakes of India are also exhibited alive in glass cases, and three times a week

practical demonstrations are given in extracting the venom from the snakes and on feeding them. It appears that antivenene as at present prepared at Kasauli is useless for the venom of any but the Cobra and Naia Tripudians.

The following are the snakes exhibited: Cobra, Naia Tripudians, common Krait, Bungarus Cœrulens, Fursa, Russell's Viper, and the green pet viper, Lachesis anamallensis, one of the representatives of the Rattlesnake in India.

Through Mr. Mahalaxmiwala, Superintendent of the Victoria Gardens, Bombay, about fifty living specimens of plants, mainly of economic value representing Rubbers and Fibres, adorn the Economic section, and there may be also seen here a specimen of the teak and camphor trees. A specimen of the quinine plant, the only one probably in the Presidency, was also exhibited.

Bearing in view the short time granted in preparing for the Exhibition, *viz.*, about two months, and the sum allotted for expenses of the Forest Section, Rs. 2,000, the latter may be said to have been eminently successful.

Mr. G. M. Ryan, F.L.S., Deputy Conservator, Bombay Presidency, was the organiser of this Forestry Exhibit, and he is to be congratulated on the success which has attended his efforts.

*'TREES.' VOLUME I—BUDS AND TWIGS.

BY H. MARSHALL WARD, SC.D., F.R.S.

This work will form a valuable addition to the library of anyone who is interested in the fascinating study of nature as revealed by a first-hand acquaintance with the living plant in its natural state. It is the first of a series of volumes whose purpose is to provide students of Forest Botany with a guide to the study of trees and shrubs from the point of view of the out-door naturalist, while at the same time interesting them in a somewhat closer examination in the laboratory of the objects observed out of doors. This volume ably fulfils its purpose, and will afford a refreshing stimulus to the student to observe and think for himself.

The work is divided into two Parts—I, General, and II, Special. In Part I, the author deals comprehensively with the shoot system and its differentiated parts, describing in turn, with numerous examples, buds, their position, arrangement and structure; bud-scales, the arrangement of leaves in the bud, the opening of the bud and extension of the shoot, different kinds of shoots, the tegumentary system—epidermis and its outgrowths, and periderm (cork), leaf-casting and the formation of leaf-scars, twigs, lenticels, and finally certain accessory characters of twigs (hairs, bristles, prickles, spines, tendrils, etc). Part II is of a more special nature, and consists of a classification of the trees and shrubs commonly met with in England, according to the characteristics exhibited by their buds and twigs. Even to merely outline the system would be beyond the scope of this review ; suffice it to say that the classification has been most carefully worked out and the arrangement is clear and concise, the language being free from unnecessary technicalities.

The book is admirably illustrated throughout. Some of the illustrations have appeared elsewhere, but a large number are new ; they form an indispensable adjunct to the text.

* 'Trees,' a Handbook of Forest Botany for the Woodlands and the Laboratory, by H. Marshall Ward, Sc. D., F.R.S., Volume I—Buds and Twigs. Cambridge Biological Series, Cambridge, at the University Press, 1904. Price 4s. *6d.*

We may conclude by quoting a passage from the author's Preface in support of the plea that the branch of study revealed to us in the present work is no mere amateur's hobby, but may be profitably pursued by the expert: "Rarely have I experienced a greater surprise, or enjoyed days of field-work more, than during a fortunate visit many years ago to one of the greatest Forest Botanists ever known to Europe: he could recognize practically every species of tree, shrub, or bush we met with, from the smallest piece of twig with one or two internodes on it, or from a mere *fragment of its wood or bark or leaf, and if* anyone is inclined to regard such knowledge as barren, let him look into the work that Robert Hartig accomplished during his lifetime."

EXTRACTS FROM OFFICIAL PAPERS.

NOTE ON GERMINATION OF TEAK AND OTHER SEEDS.*

I.—TEAK.

1. Teak seed, if not previously prepared, germinate best in the second year after falling from the tree. The result of this feature in the germinating power of teak seed is that double sets of seed beds are required in a nursery, which involves loss of area and extra expense in keeping the beds clear of weed, etc.

2. As the area of the Godhra Forest nursery is limited, it has been found necessary to determine the best method of forcing teak seed, and to do this the seed has been forced by three different methods and the result carefully examined.

3. The first method, under which a large quantity of seed was treated, consisted in laying out the seed in a thin layer on a gravel path and exposing it to the heat of the sun for over two months, the seed being turned every fortnight, so as to expose all sides to the heat. Before the rains set in the seed was sown on raised seed beds, previously prepared, as *described at* the end of this note. This method was suggested by Mr. Damle, Extra Assistant Conservator of Forests, Nasik, and will be referred to later as Damle's method, No. I.

4. The second method which was tried consisted of putting teak seed in layers about one inch thick in a pit 10 feet square and 18 inches to 2 feet deep with alternate layers of earth of the same thickness. The whole was filled level with the ground, with alternate layers of seed and earth, and then flooded with water every other day, five times. The whole mass was then thoroughly mixed and again watered on alternate days, until the seed showed signs of germination. This method may be called for reference "The Modified Burman method, No. II."

5. The third method consisted of putting teak seed in pits, 4 feet square and 2 feet deep, flooding the whole for four days

* This note was very kindly placed at the disposal of the Hon. Editor by the Conservator of Forests, Northern Circle, Bombay.

and drying the seed on paths for four days by spreading it out in thin layers and repeating the process until the seed showed signs of germination. This may be called the "Local method No. III."

6. The seed used in these experiments was collected in the Panch Mahals, and is therefore local seed. Five hundred pounds or over were treated by each method and 1,000 seeds of each kind were carefully selected and sown in separate raised beds, for the purpose of estimating the relative value of each method.

7. The results observed are as follows:—

(*a*). All three sets of 1,000 seed were sown on the 4th June 1904.

(*b*). Rain fell 2 inches and 17 cents on 11th June 1904.

Do.	0	do.	29	do.	21st	do.
Do.	0	do.	19	do.	4th	July
Do.	1	do.	87	do.	5th	do.
Do.	1	do.	43	do.	7th	do.
Do.	1	do.	58	do.	11th	do.

(*c*). On the 21st June 1904 one teak seed germinated out of the 1,000 treated under the Local method No. III (the beds containing seed treated under observation, also showed plentiful signs of germination on this date, but not those treated under Nos. I or II).

(*d*). On the 8th July 1904 all three sets of seed showed signs of germination.

8. After this period the number of seeds which had germinated in each set of beds, containing 1,000 seeds each, were counted, giving the following results:—

Date.	Damle's method No. I No. of seed germinated	Modified Burman method No. II. No. of seed germinated.	Local method No. III. No. of seed germinated.
22nd July 1904 ...	65	312	22
29th „ „ ...	99	335	27
20th August 1904	100	313*	27

* Some plants killed by a cockchafer grub.

9. The beds which were not under observation but sown with the three differently prepared kinds of seed show similar results to the above, except that the difference in the methods Nos. II and III was not quite so marked as in the experimental beds. No. III germinated first both in the common beds and experimental beds. All the beds of seed treated under method No. II gave most excellent results, and roughly 60,000 to 70,000 plants were obtained out of 500 lbs. of seed treated under this method.

II.—KHAIR SEED.

10. Khair seed requires no previous preparation, but germinates readily after a moderate rainfall. It should, however, be sown in raised beds, as excessive moisture rots the seed. Last year 15 bags of khair seed were lost by heavy rain falling on it. This year, to avoid similar failure, the seed was sown and watered by hand ten days before the break of the monsoon. It germinated on the 4th day; on the 10th day after sowing heavy rain fell which, had it not been made to germinate by forcing it previous to the heavy fall of rain, would probably have destroyed it.

III.—AIN (*Terminalia tomentosa*).

11. Ain is sown on a layer of leaves and grass so as to raise it from the ground to prevent it becoming rotten and spoilt by rain. It germinates readily after a good rainfall, and is easy to lift without damage to its root if sown on leaves.

IV.—BIA.

12. Sown in a similar manner to ain without preparation.

V.—DHAWDA (*Anogeissus latifolia*).

13. No good results have as yet been obtained from Dhawda sowings. Sowing on both heavy and sandy soil has failed. The best results, which are at best no good, have been obtained by soaking it for 24 hours in warm water. It, however, transplants easily when once up and with little loss.

PREPARATION OF SEED BEDS.

14. Mr. Damle advised digging or ploughing up the ground for the proposed seed beds in January, so as to expose the soil during the hot weather to climatic influences. This was done in the nursery and the raised seed beds prepared,

at the end of May, with excellent results. Raised seed beds are preferable to sunk beds, though the latter have to be used in the case of transplant beds where watering is done by irrigation.

R. S. PEARSON,
Divisional Forest Officer,
Panch Mahals.

MISCELLANEA.

AUSTRALIAN FORESTRY

COMMUNICATED BY J. PLUMMER.

The importance of forest conservation is beginning to receive increased attention in the Commonwealth, where the revenue from the various State forest lands remains considerably below that obtained in countries possessing far less wealth of timber. In New South Wales the forests, contrary to the popular idea in Europe and America, extend over almost the whole area of the State, excepting portions of the Monaro, Lachlan, Murrumbidgee districts, and the trans-Darling region, where extensive treeless plains occur clothed with salt-bush, scrub, or species of natural grasses. There are at the present time nearly six and a half million acres of forest reserves in the State. In South Australia there are nearly 200,000 acres of forest reserves and plantations; in Queensland, where forest conservation is of recent date, the reserved areas form a total of over three million acres; in Victoria the forest reserves cover a total area of 4,679,540 acres out of 11,797,000 acres of forest country, the balance being mostly timber country difficult of access; in Western Australia a beginning has been made by establishing forest reserves forming a total of over a million acres out of an estimated total of 20,000,000 acres; while in Tasmania about 33,300 acres have been reserved for timber-planting and growing. The total area of forest land in the latter State is about 4,000,000 acres, and it has been estimated that the forest lands of the Commonwealth cover an area of over 60,000,000

acres. The trees met with are chiefly species of Eucalyptus, Angophora, and other genera of the order *Myrtaceæ*. The prevalence of the eucalypti, and the large extent covered by the forests, give the country a rather monotonous aspect; but the park-like appearance of the open forests and the beauty of many flowering shrubs win admiration in spite of the sameness of the trees; while even the dull, greyish blue of the foliage of the gum trees, when relieved by the yellow blossoms of the wattle, including the graceful myall, or the beautiful and shapely kurrajong, is not without its attractiveness. The trees are, for the most part, straight and cylindrical in the trunk, and when full grown, their first branch is at a considerable height from the ground. The roots of the eucalyptus often lie at no great distance from the surface soil, an adaptation of nature to the peculiar climatic conditions of the country. The finest specimens of many of the timber trees, those yielding the most valuable timber, are found on ridges and hill sides, in places frequently too rough and stony for cultivation. In Western Australia the most valuable indigenous timbers are the jarrah, twart (or torart), sandal wood, karri, and several others. In Queensland cedar timbers are abundant; also in the northern portions of New South Wales, some of the logs obtained being of enormous size. One characteristic feature of Australian hard-wood trees, of which there exists an almost endless variety, is the great size of the beams which may be obtained from them, as well as for the extreme toughness and durability of their wood; the grey ironbark having a resistance to breaking equal to 17,900 lb. per square inch, as compared with a mean of 11,800 lb. for English oak and 15,500 for teak. None of the other timbers have so high a resistance to breaking as this description of ironbark, but nearly all the varieties have a greater strength than oak. The quality of the wood is materially influenced by the soil on which the trees grow, while the absence of branches for the greater portion of the height enables the timber to be obtained to the best advantage; and as full-grown trees of most varieties are rarely less than 100 feet high, with corresponding girth, the quantity of timber obtainable from the virgin forests is very large. In New

South Wales the timbers of commercial value, many of which are found in the other States, include white or she-ironbark, narrow-leaved ironbark, broad-leaved ironbark, mugga, or red ironbark, blackbutt, white mahogany, tallow-wood, spotted gum, grey box, red mahogany, grey gum, forest red gum, Sydney blue gum, and turpentine, the latter resisting the attacks of white ants. One of the most useful trees is the red cedar, the wood of which, somewhat resembling mahogany, is well adapted for the finer kinds of cabinet-makers' work. Some of the cedar trees grow to immense size, as much as 2,500 cubic feet of valuable timber having been obtained from a single tree. Many of the woods of the minor trees are beautifully grained, and capable of receiving the highest polish, while others are fragrantly perfumed. These woods are adapted to the finest description of cabinet-making, and it is strange that their merits should have so long escaped attention. Amongst these trees may be mentioned the rosewood, tulipwood, yellowwood, white maple, white beech, myall, marblewood, mock orange, and many others. Besides their use for cabinet-making, many of the brush timbers are of great utility for the rougher kinds of carpentry; while some, both hard and soft woods, are admirably adapted for coachbuilders' and coopers' work. "Colonial deal" is an excellent timber, and is obtained in very large scantling, the tree frequently reaching 120 feet in height. It is soft, close-grained, easily wrought, and remarkably free from knots. Its use therefore is extensive for cabinet-makers' work and house fittings. The value of the exports of Australian timber, dressed and undressed, from Commonwealth ports in 1903 was £745,490, of which the undressed timber, chiefly from Western Australia, represented £739,317.

NEW SOUTH WALES HARDWOODS FOR STREET PAVEMENT.

The question of a proper material for road-making and street pavement is one which every large Municipality in India has seriously to consider. The introduction of electric traction has,

in a great measure, revolutionised the conditions in cities which had already begun to feel the strain of a heavy horse and cart traffic consequent on an increasing prosperity, an increasing population and, yea, an increasing luxury. The lotus-eating days are over. The days of the soft pad of the elephant and the camel and of the slowly moving cumbersome wain are gone. Life, be it spent in the pursuit of commerce or mere luxury, is strenuous and locomotion is useless unless maintained at high speed. It is necessary to state the obvious in dealing with a matter which has puzzled Engineers who have been successful in solving intricate problems of drainage and water-supply. During the *régime* of Mr. M. C. Murzban, who may perhaps be accepted as the greatest expert in India in street roads, Bombay had probably the best streets in India. There was a plentiful supply of good material at hand and labour was cheap and intelligent. Yet we find Bombay now dissatisfied, and experiments are in train to treat the principal roads with oil and tar, to prevent the dust resulting from abnormal wear and tear. In Madras they are also in trouble with their roads, the worst perhaps in all the capitals; and in Calcutta there are loud cries of the failure of moorum. In considering the whole subject, we have been struck by a deficiency which, to say the least, is remarkable. In many large cities of the world outside India wood is largely used with success for street paving; but it does not appear to have entered the heads of any of the larger Municipalities in India to adopt a means as old as civilisation but as effective as ever. The Howrah Bridge, at Calcutta, over which there passes a traffic in volume and weight second only to that of London Bridge, is floored with wooden battens, and they have proved so economical and enduring that the wonder is that all the approaches to the Bridge are not treated with like material in the form of wooden blocks. Wood, as a paving material, is comfortable, sanitary and decent, and, after the initial cost has been overcome, much more economical than any other material. In the great and beautiful city of Calcutta wood-paved streets would be a boon to the Municipality and a blessing to the inhabitants. Life in the large thoroughfares

like Chowringhee, Dhurrumtollah, Old Court House Street, and Bentinck Street has been made hideous by the jangle of the electric cars, the rattling of gharries over the rough ill-cut cobbles with which the tramway track is paved, and the vibration of all this heavy traffic. During the hot weather, when the wind is high, people are blinded by dust. When it rains, or the streets are watered from the public hydrants, the road material forms a clayey puddle and a danger to the pedestrian, to the cyclist, and the horseman. From whatever point of view, therefore, the present conditions are unsatisfactory and should not be allowed to continue when there is a satisfactory solution of the difficulty at hand.

Having decided to experiment with wood, the next point to consider is the species to be employed, and there appears little doubt that the hardwoods of Australia, and particularly those of New South Wales, which can be procured in abundance at a rate impossible for even the produce of our own forests, are the best. They have stood the test of experiment; and it may be interesting to mention that in Colombo, where the climate in summer differs little from that of Calcutta, and the mode of life is much the same, the Public Works Department are strong advocates for wood paving. It has been found by experience both in Australia and England that the Australian hardwoods wear better than pine or plain deal, and are more hygienic from the fact that they are less absorbent than soft woods, and do not easily become greasy. Even when laid in connection with electric tramways, it was found that the wear of these woods against the rails was better than other woods, was clean, noiseless, easily scavenged, and gave no trouble from expansion. Anything more ideal could hardly be wanted for Calcutta, where the electric cars have brought nothing but trouble in their wake.

In Australia, the testimony to the value of wood paving is very high. The climatic conditions there are not unlike those in India. They have sudden and great changes of temperature. In summer the atmosphere is hot and dry, and during the rains the humidity is heavy. Nothing could be more trying to a woodpaved

road, yet the City Surveyor of Sydney says that making full allowance for depreciation and contingencies the *minimum* life of wood pavements may safely be considered as about fifteen years. Mr. MacCabe, the Calcutta Corporation Engineer, whose life has been made miserable by moorum, will probably rub his eyes and never be happy till he gets Blackbutt, Blue Gum, or Red Mahogany for his main roads. In New York they have found such answer well, for, as one Engineer expresses it, "it is not a case of preserving wood, but of wood preserving itself."

As the question of cost is likely to frighten Indian Municipalities who have an exaggerated notion of the expensiveness of wood, we may at once say that comparsions between the cost of hardwoods and macadam show materially in favour of the former. The annual expenditure for repairs during the lifetime of a pavement must necessarily be a variable item, although it must obviously be less for hardwood than for macadam, which so readily crumbles. In addition to this there is the considerable advantage, especially in busy carriage ways, of the thoroughfare being less frequently closed for renewals, which is a matter of great importance to business-people, shop-keepers and others.

In the matter of hygiene there can be no question of the superiority of the timber roadways. They are less absorbent than stone-metal and do not soak up the sewage of the streets. Given therefore ordinarily good surface drainage in Calcutta, streets so paved should never become greasy and slippery and, on the other hand, never accumulate the particles of dust which are thrown up in the air to the destruction of our pulmonary tissues.

A series of observations made by the London police during fifty days in the busiest streets of the metropolis gave the following results :—1,066 horses fell on asphalte, 719 on granite, and 542 on wood. These results are confirmed by the well-known report of Colonel Haywood, formerly City of London Engineer, who stated that horses might be expected to travel 132 miles over granite, 191 over asphalte and 446 over wood, without accident. He also noticed that horses falling recovered their feet more easily on wood than on either asphalte or granite, and that

the accidents were much less serious. Wood is undoubtedly the material most approved by the public, whose demand for a noiseless pavement is not likely to be relaxed. Business is impossible and residence distressing in a busy street paved with material on which traffic produces a continuous clatter, like in Old Court House Street over the tramway cobbles. Wood or asphalte are the only materials which approach the ideal of a noiseless pavement, and between the two in that regard it is difficult to decide.

A. M. I.C.E.,
in *Indian Engineering.*

NEW WOODS.

Continuing our observations on the outlook for the development of the West African timber trade, after explaining how mahogany has commanded the premier position as a furniture wood, we must now consider what possibilities there may be for new and untried timbers.

We have shown that mahogany contains within itself possibly more attributes as a par-excellent material for furniture construction and for high-class fittings than any other wood; the position has not been attained by a mere decree of fashion, but rather by its abundance and relative cheapness, combined with a beauty of appearance and a capacity for sustaining a high finish and polish. It is not too difficult to season nor to work; further, when made up it is not liable to warp and twist; another important factor in its favour is that its specific gravity is not extreme. What then are the conditions which must determine the successful introduction of strange woods?

If they are only equal to those which they seek to supplant, they must, in the first place, be cheaper; if they become supplementary they should be at once competitive; in addition, there should be some reasonable guarantee as to the continuity of supplies. Thus pitch pine did not displace Danzig and Memel fir logs because its price was higher, but rather by its cheapness and better specification.

If a new wood has any special beauty of colour or figure, even if the price is higher, it may command a limited market, as the country is not overstocked with prodigal millionaires, and if any great consumption of any wood is to be stimulated, it can only arise from the requirements of the greater number who have only limited pockets.

We have, during a long course of years, taken every opportunity of carefully examining the many sample shipments of woods which from time to time have come forward; and it is surprising to find how few can compare with the recognised woods of the market. It might add force to our remarks were we tempted to name in detail the varieties in our mind, which fail in some way to fulfil the conditions requisite to secure their acceptance as a staple commodity, but we desire to avoid saying what might be detrimental to the interests of any, and our regret would be extreme if our remarks in any way tended to the damping of commercial enterprise, especially should they result in the prevention of the successful introduction of one wood with only half the attributes characteristic of mahogany. We therefore prefer to speak in a general sense to guide those who, whilst lacking any great expert knowledge of the various furniture woods available in this market, are in actual contact at some point of the globe with timber peculiar to the district.

At the outset, it may be permissible to say—that the mere fact that a tree attains to this or that size, does not prove that it contains good timber; were this so, horse chestnut, Sapeli wood, and jarrah, by their size alone, would at once become recognised furniture woods. We are further free to admit that many foreign woods may, at their point of growth, have a local value, either by the cheapness, or the absence of any competitive woods, and possibly they may serve the primitive requirements of the district, but the same wood shipped to this country, with all the incidental charges arising from transport, would not enter into competition with those already recognised. We are not sure that Mr. Weale's suggestion as to a representative collection of samples would solve the problem, for to judge woods in a

glass case would be like attempting to decide the merits of a stuffed bird as to its qualities as a food.

As to naming of timber and its proper classification, it is not so simple as Mr. Weale appears to think, and whilst we admit that the confusion in the nomenclature is puzzling to a degree, we fail to see a remedy.

The work of our international classification of timber is beyond the grasp of any committee of inspection—practical men lack the knowledge of the botanist, whilst the botanist lacks the practical experience to enable him to arrive at a decision that would be acceptable to all. Consider for one moment the part which local names play and must continue to play; even Baltic fir is known in London as "yellow," whilst on the East Coast it is redwood. Then there is the question of coined or commercial names, such as "satin walnut" for a "gum," and "hazel pine" for the sapwood of "gumwood," and "bay poplar" for a species of "tupelo," and so we might multiply the list, but we have shown that a simple classification of timber is impossible. If the strange woods are to find a market, it will not be by the aid of museums, but they must be put on the market, bought and sold, and worked up for such purposes as they may be suitable, and experience will soon decide their utility, either for furniture woods, carriage construction, or engineering work, and if they are only good turnery wood they will find their level.

If for furniture, they must contain in a greater or less degree those virtues found in mahogany, not be of too great specific gravity, not too difficult to season, and yet possess a cohesiveness of fibre so that they do not unduly check and split, combined with beauty of colour and figure, and capable of taking a good polish.

If for carriage and wagon purposes, or for engineering work, they should possess the qualities of oak, strength and elasticity, and not be too heavy or potty. Each wood must be put in the market at prices to compete with those already recognised.

The lowness of price, combined with excellence of quality, is bound to stimulate consumption, but it must be apparent that it is not to the interest of cabinet-makers, architects, and engineers

to stipulate for unknown and untried woods, especially of those of which there is no guarantee for their continuity of supply.

We feel that at the moment there is not a good outlook for new woods, especially when we consider the present low prices of known woods—American oak planks below 2s., mahogany as low as 2¼ brokers' measure, but the world is moving rapidly, and with the revival of trade in the States and this country, we shall see an increased demand for woods of every description, so that the swing of the pendulum is bound to find room for woods which are at present despised.

Of this we are assured that every wood has its utility, and as known cuttings become depleted, or their values appreciated, so will woods, at present ignored, except at prices that are ruinous to the shippers, find in the near future an acceptable market.

Whilst it is desirable to see the area of supply enlarged, and the process of creating a demand continued, it is a pity to cut down to any extent standing timber, merely to be slaughtered.

Standing timber of every description has a value which of necessity we must appreciate, whilst felled or manufactured timber may be sold at prices that will not bring out freight and charges, and if stored, may eat itself away with interest and charges.

It should be recognised that the introduction of new woods must at the outset frequently result in loss to the shippers—especially in the present state of trade and depressed values all round; hence the greater need of discretion, coupled with a discernment to bring them forward at the crucial moment, when trade is good, and recognised woods are either scarce or dear.

In putting forward these suggestions we do not claim by any means to have exhausted the subject, and it should be noticed that it has been treated chiefly from the view of furniture woods and that of hardwoods in general, but without regard to small ornamental and turnery woods, and that no attempt has been made to trace the position and prospects of soft woods.—*Timber Trades Journal.*

ARTIFICIAL DRYING.—Wood drying by the hot air process is now practised somewhat extensively in Sweden, with the result that shipments arrive at discharging ports in much better condition

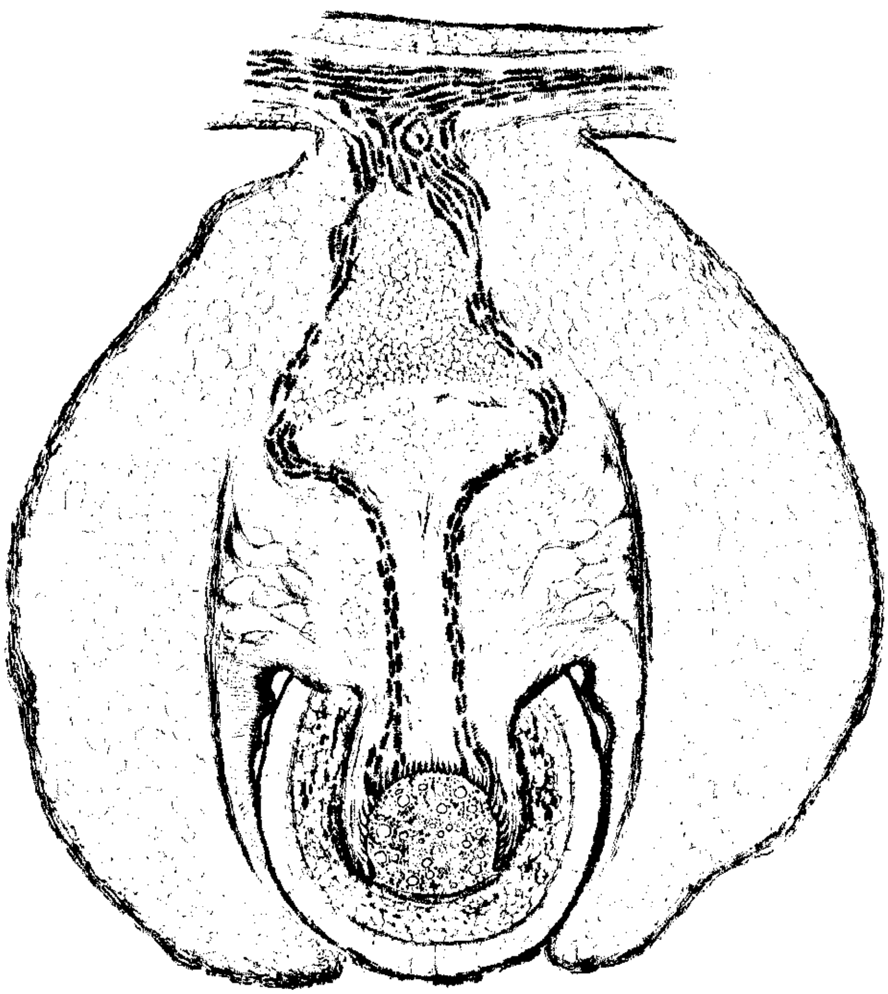
than formerly, to the satisfaction of both exporter and importer. It cannot be too strongly impressed upon shippers that allowance made for goods being out of condition seldom proves sufficient compensation to buyers, as, although the amount awarded is in many cases ample when only the strict conditions of contract are taken into account, it never makes good to a purchaser the annoyance and loss experienced in seeing his competitors move off their bright goods with facility, while his discoloured parcel is left on his hands to suffer, it may be, further deterioration. There are many exporters who fail to grasp the fact that, when once a deal or batten is thoroughly dry within, the damage done by a shower or two of rain is of no great consequence ; but if the wood retains only a small percentage of moisture, rain and damp weather will rapidly bring the fault to the surface, with disastrous results. It has been found again and again, and particularly this year, that goods which have been landed in bright condition, and apparently thoroughly seasoned, have slowly become mouldy when stored in the yards in close piles, particularly under shed in hot weather, and in places where there is no strong current of air. These annoyances are due solely to undetected moisture lurking within ; but, as far as experience goes, they might be easily obviated by the new system of artificial drying. We understand that the mills that have adopted this plan of seasoning their shipments find that the extra expense is more than balanced by the stoppage of claims on this side, to say nothing of the great gain in interest obtained through goods being ready for delivery months earlier than under the old system, and it would be interesting to the trade in general to have some statistics showing how these figures work out, particularly as to claims. It is somewhat singular that while several Scandinavian shippers were, as far as we know, the first to adopt this system and while other exporters in Sweden and Norway are inclined to follow the example set, the Russian and Finnish exporters still stand aloof. Is their want of action owing to a disbelief in the efficacy of the process, or is it simply adherence to old-fashioned methods ? Another fact which further accounts for the better condition of Swedish goods is that covered

lighters are used much more extensively in Sweden and Norway than on the other side. The loss to many of the Russian shippers, especially at Cronstadt, through the deterioration suffered by goods owing to exposure to weather, coal dust, etc., must be very great, and should, we think, be easily obviated if energetic measures were taken to institute a better system.

ARBORICULTURE IN THE UNITED PROVINCES.—Considerable progress is being made in the extension of roadside avenues, though the heavy rains of 1903 damaged young trees in some districts. Private individuals have been encouraged to assist in planting avenues in various districts of the Agra, Rohilkhand, Allahabad, and Fyzabad divisions, and in the Fatehpur district no less than 21½ miles of avenues were planted in this manner.

WEBSTER'S FORESTERS' DIARY.*—Webster's Foresters' Diary for the year 1905 is now ready—and judging by the splendid reception accorded to the previous issues and the many suggestions received from recent purchasers, which have been embodied in the present issue, will not only please previous subscribers, but will bring new ones, who will fully appreciate the work expended on it by the author, Mr. A. D. Webster of Regent's Park. The diary should, in the year of grace 1905, be of the greatest use to the estate agent, the home timber merchant, and the forester. The familiar dainty red-leather binding, with gilt lettering thereon, has again been adopted, whilst an inner pocket for the insertion of letters, cards, etc., and a pencil in a pocket at the back, adds to the usefulness of the book. Amongst the many items of interest to be found within its many pages (which, being of specially prepared paper, take up such a little space) will be found concise remarks on forestry for each month of the year, rules for planting, thinning and pruning, willow culture, trees for various soils and situations, timber measuring and valuing, profit and loss of barking oak, as well as a complete list of Foresters in every part of the United Kingdom—in short, everything connected with forestry and allied industries is touched upon.

* Webster's Foresters' Diary, 2s. 6d. nett. London: William Rider & Son, Ltd., 164, Aldersgate Street, E. C.



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Lith. by S. C. Mondul.

SCIENTIFIC PAPERS.

THE HAUSTORIA OF SANDAL ROOTS.

BY C. A. BARBER, M.A., F.L.S.

The study of the relations between parasites and their hosts is always interesting. We are well accustomed to the presence of animals permanently fixed to others, but that plants should obtain their nutriment by sucking the juices of other plants comes at first as a matter of surprise to the students of the vegetable kingdom. The true nature of such parasitism was not understood until comparatively recent times. For many years it was largely held that fungous outgrowths were a sort of malformation of the plant tissues, and were classed as a kind of disease similar to the galls caused by insects and the tumours of the human body. And although the fact was soon ascertained that there was organic connection between higher plants as well as fungi, it was assumed that the phenomenon was of this tumour nature, and attempts were even made to explain why so great a change in flowers, leaves and fruits should have been brought about.

With our present knowledge of the ravages of fungi upon the tissues of the higher plants, it is not easy to understand the difficulties which offered themselves to early students of plant parasites. The best work of many brilliant Botanists has been devoted to the subject, and we have now a fairly comprehensive knowledge of the manner in which the fluids pass from host to parasite. But the fact that, besides fungi, highly organised green flowering plants, such as the sandal, obtain their nutriment by this irregular means still remains one of the wonders of the vegetable kingdom. It is to this study that I wish to direct attention, especially as all the facts have by no means been elucidated.

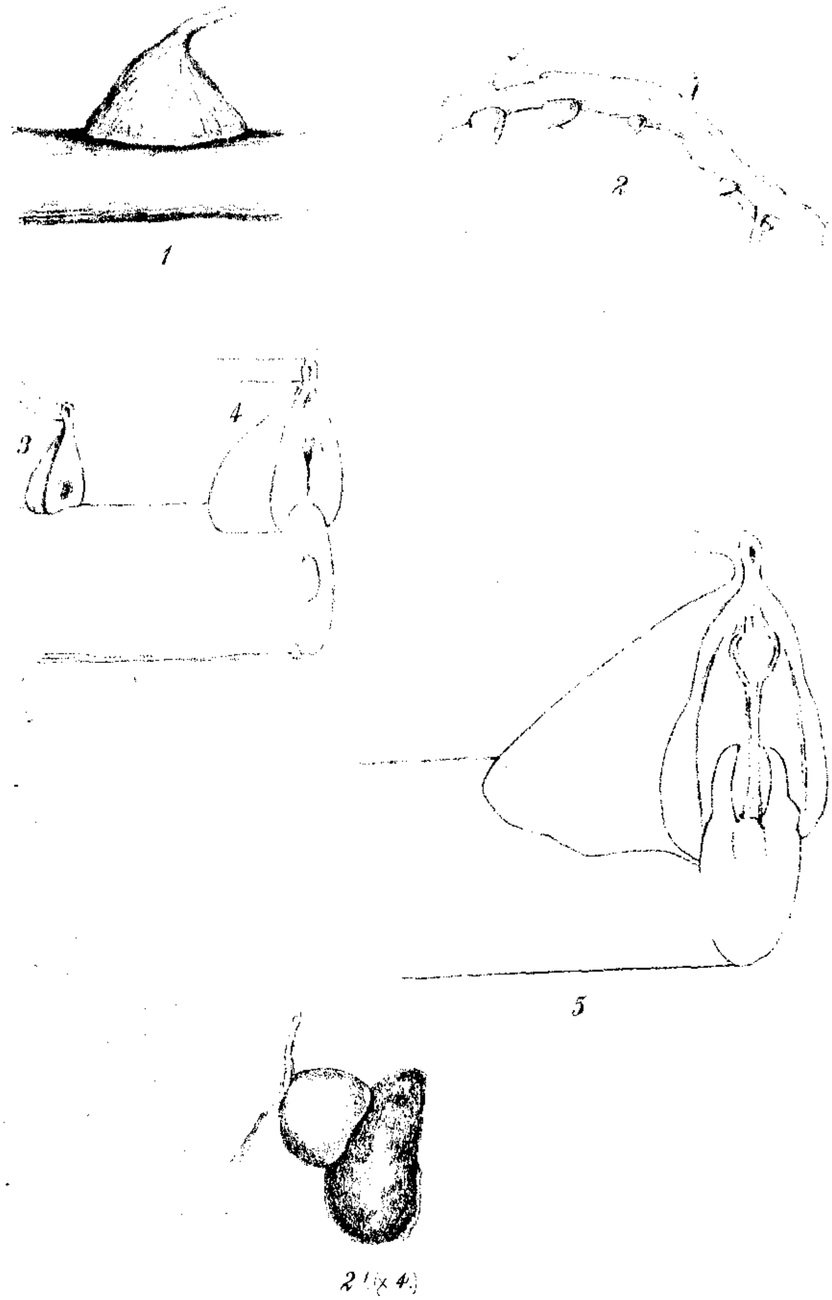
Of phanerogamic parasites there are a large number in India ranging from semi-parasitic crop weeds, such as *Striga*, differing little from the ordinary flowering plants, to such forms as *Orobanche*,

without chlorophyll and with brown scale-like leaves, and the still more mysterious *Balanophoras* of the ghaut forests, whose only resemblance to the higher plants is seen in their spikes of brightly coloured little flowers.

These parasites may be roughly divided into two *main* classes, according as they attack parts above or below the ground. Of the former, the Indian mistletoes, *Viscum* or the more numerous species of *Loranthus*, the common thread-like *Cassytha* of our dry forests and the various forms of dodder or *Cuscuta*, may serve as familiar examples. They are aërial in their growth, and fasten themselves on the stems of their hosts. Of the other class, the root parasites, the sandal is perhaps the most highly organised, forming as it does a luxuriant and handsome tree, laden with masses of green leaves, flowers and fruits.

It would seem that until recently those who had to do with sandal plantations were uncertain as to its parasitic nature. But it is now beginning to be a matter of some doubt whether the sandal takes its root-nourishment in any other way than by sucking the juices from adjacent plants.

Although the organs of attachment, or "haustoria" as they are called, will adhere to the most unlikely substances, yet in sandal, as in other root-parasites, there would appear to be a certain amount of selection exercised as to its hosts. We have thus been led to speak of such plants as *Tecoma Stans*, *Cassia siamea*, *Casuarina equisetifolia*, *Pterospermum Heyneanum* and *Lantana Camara* as good "nurses," thereby meaning that the sandal grows readily in the company of these plants. This is no new fact, and the most various explanations of it have from time to time been offered. Shade, aspect, the formation of humus, and so on, have been brought forward as dominant factors in the association of sandal with these plants, and it is curious that it did not occur to those interested to study the root system more carefully and to test the sandal's so-called "doubtful parasitism." From pot experiments and from examination in the field it appears that the sandal attaches itself with avidity to the roots of the good nurses referred to, and it is therefore justifiable to assume



Lith. by S. C. Mondul.

that this underground affinity is of more importance than any questions of shade, aspect or locality. Within certain limits, the condition suitable for the best nurses will be those most likely to produce the most healthy and rapidly growing sandal trees. The effect of neighbouring plants on the quality and quantity of oil in the heartwood would form an interesting study for those Forest Officers who have the advantage of living in sandal-bearing tracts. It is quite probable that, given the most healthy conditions and the proper climate, those nurses will be most useful as oil producers which feed the plants most generously.

I propose, in the present note, as a contribution to our knowledge of sandal, to give a short description of the haustoria. It does not appear that such an account exists, although the allied little *Thesium*, from its occurrence in European regions, has been fully described by more than one observer. The ease or difficulty experienced by the sandal in its attacks on various roots may form the subject of a later communication, but, to avoid excess of detail, which would be out of place in a practical journal, I shall content myself for the present with referring to a perfectly straightforward, simple case in which the attack is easily and successfully carried out.

I have shown in a previous note that the haustorium arises independently of the presence or even nearness of surrounding rootlets. It is probable that in case no host is met with, a comparatively rare occurrence in nature, the haustorium remains small and ultimately withers away, but if a foreign rootlet is met with, it grows rapidly, and develops into a mass of white tissue, at first club-shaped, but later on adapting itself to and enfolding the surface of the root attacked, and taking on more or less the form of a flattened bell, figs. 1 and 2.

The haustorium applies itself closely to the surface of the root. It becomes enlarged at the point of contact, increasing in the direction of the root's length, and thus becomes elongated and concave with an oval outline. While the haustorium, at its origin from the parent root, frequently many times smaller than itself, remains narrow, it increases in diameter as it nears the

point of application, and thus its conical or bell-like form is assumed. These points are illustrated by the accompanying drawings and diagrams, figs. 3—5.

It is usual, when studying the tissues of the haustorium affixed to a root, to pay special attention to the section passing through the length of the haustorium and at the same time cutting the attacked root across, for in this section most of the tissues concerned are brought into view at the same time. But, thoroughly to understand the matter, it will be necessary to study the arrangement in at least three different planes. These are as follows :—

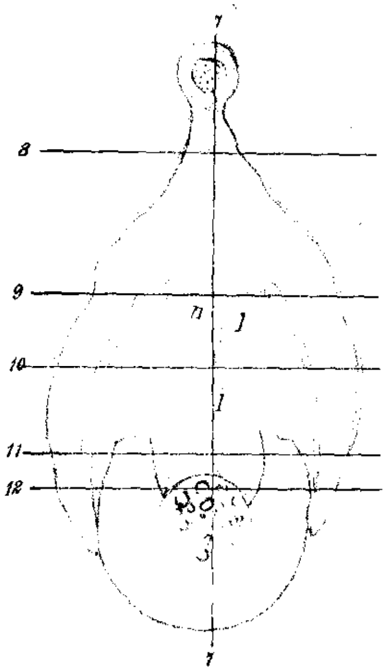
(1) *Transverse section*, cutting across the root attacked and therefore through the haustorium from its point of origin to its point of attachment, fig. 6.

(2) *Longitudinal section*, cutting lengthwise both the haustorium and the root attacked, fig. 7.

(3) *Tangential section*, cutting the haustorium transversely and the attacked root tangentially or parallel with its long axis. Figs. 8—12 show tangential sections at different levels, and their positions are indicated by the cross lines in fig. 6.

It will be seen that the name given to the section depends upon the direction in which the attacked root is cut, and this is natural, because this organ gives the haustorium its characteristic shape and regulates the internal distribution of its tissues. It will also be understood that the character of the tissue elements, as well as their arrangement, can only be determined by examining all of these sections, and to make matters clear the outlines referred to above may be consulted and compared.

The transverse section is the most important, for the reason already mentioned, and this will be studied in detail. The outline of such a section will vary much according to the relative size of the haustorium and the root of the host, to the age of the haustorium and the species of the plant attacked, and, finally, according to the ease or difficulty experienced by the parasite in its attempts at penetration. In perhaps the most usual case the root attacked is small and the haustorium spreads itself out



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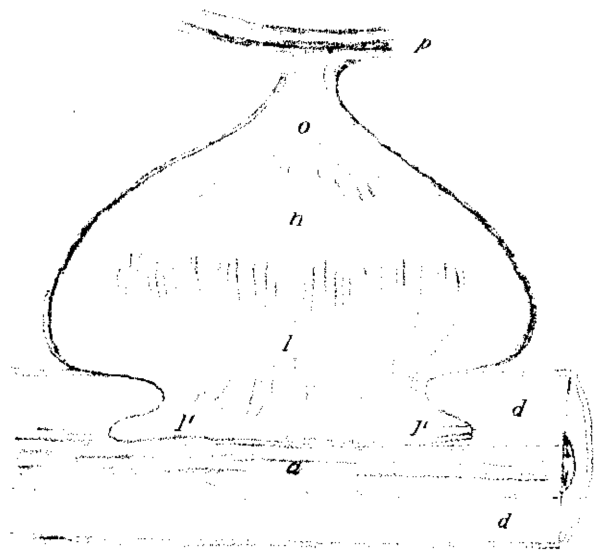

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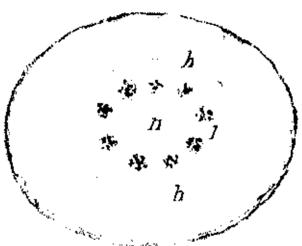

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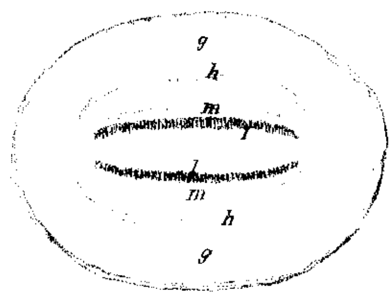

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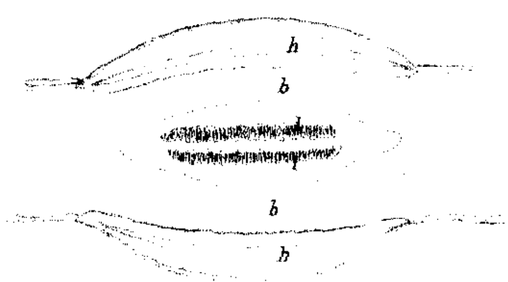

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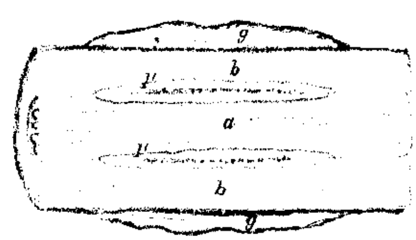

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after contact until it considerably exceeds it in breadth. Transverse sections will then remind one of the saddle on a horse's back, but to the saddle is fixed a "pack" or bundle of considerable dimensions, and the saddle is secured, not by the usual girth round the animal's body, but by a process penetrating its back, cf. figs. 4, 5, 6 and 13.

The tissues exposed in the transverse section are of great variety, showing an organ of some complexity. Taken as a whole, those of the haustorium are white and succulent, while those of the root are hardened, brown and more or less decomposed. Three main regions may be distinguished in a well-cut section :—

(1) that of the root attacked, fig. 14, *a—e*;

(2) that of the haustorium, *f—o*;

(3) that of the mother root *p*, the latter not always included if the section is not strictly median, and varying also with the direction in which the mother root is passing, cf. figs. 6 and 13.

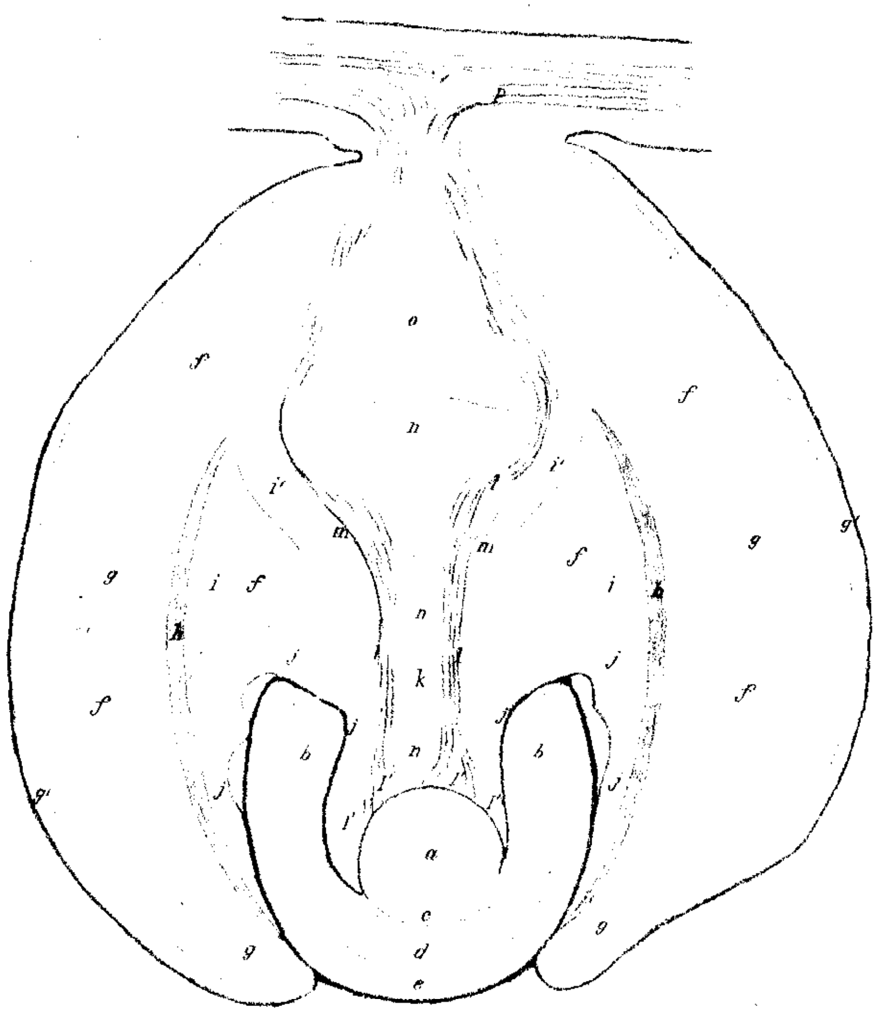
The drawing with its explanatory diagram (figs. 13 and 14) is taken from a sandal root grown in a pot with *Pterospermum Heyneanum*. The root of the host is seen to be split as far as the cambium layer *c*, while the two cortical "wings" *b* are thrust apart on either side to make room for the penetrating process *k*. The woody cylinder *a* is composed of thickened elements, and has thus been able to resist further intrusion, but it is not always so. When the medullary rays are large and the sclerotic cells of the wood alternate with thin-walled parenchyma as in *Opuntia Dillenii*, the penetrating process may proceed to the pith and even beyond it, rupturing the woody cylinder irregularly. In *Thespesia populnea* the vascular cylinder is sometimes split completely in two, and so on. The present case may be taken as typical of dicotyledonous roots with a vascular cylinder of some density. When the haustorial cells reach the cambium, they follow it to either side, and, in the case under examination, spread out until they embrace more than half the fibro-vascular cylinder. As will be seen later, it is the aim of the intruding sucker to bring its absorbent cells into close contact with the conducting

elements of the host's root, namely, the younger woody tissues. No further growth takes place in the attacked root in the place where the cambium has been invaded, the cells of this layer having been completely destroyed, but the formation of wood and bast proceeds for some time in the uninjured portion.

The alterations caused by the parasite in the tissues of invaded roots form an interesting study, which for the present must be passed over. Suffice it to say that the roots attacked are by no means passive, and, although usually ineffectively, show their disapproval in a variety of ways differing according to the species. Layers of cork, thickening of the cell-wall, the formation of thyloses and the extrusion of gum (?) are commonly met with, while the occasional cases where a sandal root becomes attached to itself show a distinct attempt on the part of the root attacked to form new tissues and occlude or grow round the haustorium.

The haustorial tissues have been divided in *Thesium* into two portions, the outer clasping "cortex" and the inner, penetrating "nucleus," divisions which may for the present be adopted.

The cortex is formed first and consists, in the mature haustorium, of non-absorbing cells which have lost their activity and have become what is called "permanent" tissue. These cells, now that penetration has been effected, have ceased to grow or divide, are fast losing their protoplasm and have become a protective layer for the younger cells of the nucleus within. But the different parts of the cortex do not cease their growth all at the same time, and the pressures and tensions exerted on the one hand by the increasing inner cortex on the quiescent outer, and on the other hand by the growing nucleus on both, have given rise to the somewhat characteristic and peculiar features now to be noted. The most striking character of the cortex is the presence of two bands of tissue *h* symmetrically placed on either side, and extending from the upper portion near the mother root down to the edges of the flaps of the "saddle." These bands, on examination, are seen to be homogeneous and



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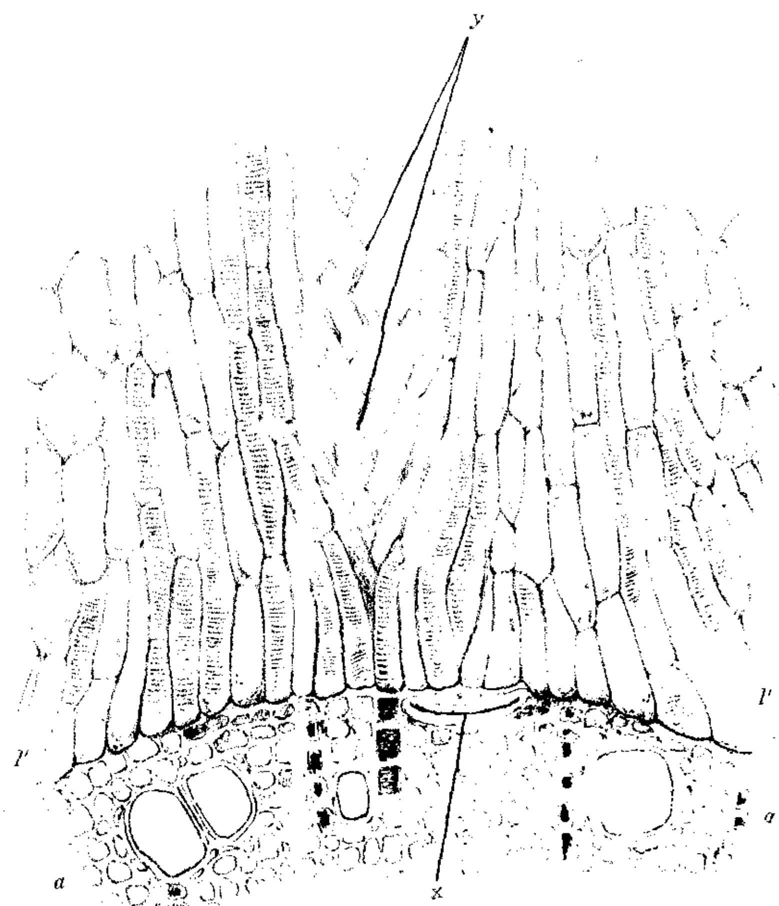
highly refractive, are very sharply marked, but without definite cell cavities. A careful study of their formation shows that they consist of the compressed walls of a number of collapsed cells. From their marked character and constant presence in all haustoria, they have been utilised to divide the cortex into an outer and an inner portion, and have been called a "separation layer." The origin of these collapsed layers, as I prefer to call them, does not seem to have been very clearly explained in the literature at my disposal (they occur also in *Thesium*), but, from a study of early stages of development, there is little doubt that they indicate lines of pressure between actively growing, turgid cells and such as have lost their turgidity and are becoming permanent. The increase in diameter of the developing nucleus and the still turgid cells of the inner cortex have exerted such pressure upon the dying cells outside, which are incapable of expansion, that the latter are crushed flat at the point of contact. That this is the correct view is supported by studying the subsidiary collapsed layers which occur in the section. These are almost always found round the borders of the cells outside *j*, between *k* and *o* and outside i^1 on either side. At *i*, on the other hand, considerable tension is exerted by the rapid growth in length of the nucleus when actual penetration is being effected, cf. figs. 4 and 5. The tissues in this region are therefore not only collapsed, but also torn asunder so as to form a series of lacunæ. All these layers are formed at different periods of growth, but, generally speaking, the internal tissues retain their turgidity longer than the outer earlier formed ones. Thus those of the outer cortex die first, those of the inner cortex *i* next, while the other portions of the inner cortex i^1 and *j* are transformed into permanent tissue only after penetration is effected and absorption is taking place. It may be further stated generally that when the junction between the tracheides of the haustorium and the vessels of the host is effected, all the parenchymatous tissues gradually lose their protoplasm and become clear, so that it is possible by observing their character to determine the age of the attachment.

Having thus cleared the ground by the study of the collapsed layers, whose presence in the section is a constant source of wonder and confusion, we can proceed rapidly to refer to the different tissues separated by them from one another.

The cells at g^1 are crushed outer cortical cells. They take the place of cork and afford an outer protecting layer to the organ. Periderm is not usually formed, but has been detected in certain cases, *e. g.*, *Pithecolobium dulce*. The cells of *f*, *g*, *h*, *i* have been already referred to. The tissues at l^1 remain active for a longer period than the rest. That at *j* surrounds the two cortical wings of the root of the host on all sides. The cells are arranged side by side at right angles to the surface of the wings, and have probably been absorbent or capable of absorption in earlier life.

In the nucleus, *k*—*n*, the cells at *n* have become permanent with or without a collapsed layer down the middle. They do not appear to take any part in absorption, and definitely terminate at some distance from the woody cylinder of the host. These cells are much elongated in the lower part of the nucleus, but in the upper, expanded portions are more or less isodiametrical parenchyma. They are sharply marked off these by a collapsed layer from the cells of *o*.

The effective portion of the nucleus may be divided into two parts, an upper, conducting and a lower absorptive. The two vascular strands *l*, composed of tracheides, are early set apart as conducting tissue, to transfer the stream of water and salts from the host to the mother root. A glance at these strands shows that they are parallel for the greater part of their length, but that they widen out at both ends. The widening at the lower end is trifling in the figure, but is sometimes very noticeable. It depends on the diameter of the woody cylinder of the host. The widening at the upper end is sudden and constant, and is less easy to explain. A study of the tangential sections through different heights of the nucleus will furnish a possible solution of figs. 9 and 10. It is seen there that the number of tracheides in the nucleus are about the same in quantity at these two levels. In the lower part, which is drawn out in the direction



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of the host's root, the tracheides are arranged in two parallel bands. In the upper part, which is much narrower, the tracheides are arranged in a circle or nearly so. The widening seen in the transverse section is necessary to accommodate the whole series of tracheides so that continuity shall not be broken in the passage of the fluids. The suddenness of the expansion is not explained, and it is more probably due to the fact that the lower portion of the nucleus alone takes part in the rapid elongation, when penetration takes place, while the upper expanded portion is enabled to increase in the ordinary, radial direction.

Outside these tracheides, on both sides, there are certain thin-walled cambiform cells *m*. Fortunate sections show that these cells have arisen from the same mother cells as the outer tracheides, and their position indicates that they form a short-lived cambium by which new tracheides can be added to the vascular strands when needed. There is no appearance of sieve-tubes in the sections examined. A much smaller band of meristematic tissue is seen on the inner side of each strand in some sections, but it does not appear to be of the nature of cambium and has no apparent relation to the adjoining tracheides.

The absorbing portion of the nucleus is seen at *l'* and in fig. 15. All the cells of the nucleus in contact with the woody cylinder of the host take part in this work, and direct connection is readily traceable under the microscope between the elements belonging to the two roots. In one sense this is the most important and interesting part of the haustorium.

The absorptive cells consist of tracheides and elongated parenchyma between them. The tracheides sometimes communicate directly with the vessels of the host, but are generally content to apply themselves to the wood parenchyma. The parenchymatous absorbent cells apply themselves to all the parts not occupied by the tracheides. Here the real transference of nutriment from the host to the sandal takes place, and the whole apparatus is designed both to protect this vital part from harm and to expose to the action of the haustorial cells as large a surface as possible of the conducting cells of the host.

The action and arrangement of the tracheides differs according to the species of root attacked. In some, as *Jatropha curcas* and *Coleus sp.*, where the vessels of the vascular cylinder occur in well-separated radial rows, they appear to be only applied to the ends of these rows of vessels.

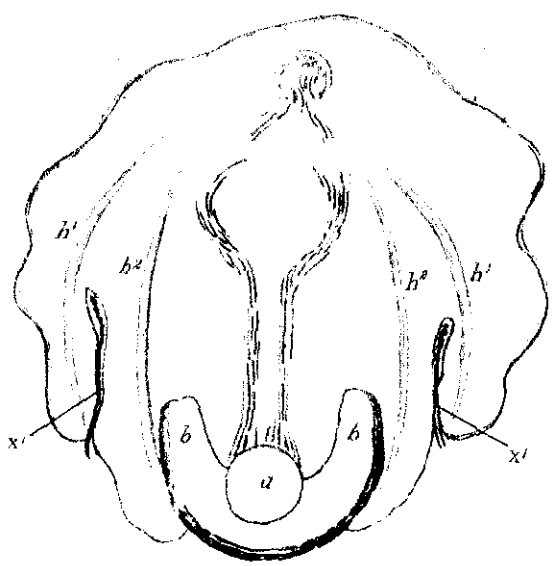
But in the majority of cases examined they are in contact with all the elements of the wood alike. Usually in intimate contact, the cells and tracheides of the haustorium are sharply separated off by cell walls from the elements of the root attacked. In some, however, as *Gyrocarpus jacquini*, the tracheides actually appear to penetrate the vessels after the nature of thyloses.

The cells of the haustorium differ a good deal as to the nature of their contents. Those of the nucleus are, taken generally, filled with granules and protoplasm (with the exception of course of the area of tracheides), and this gradually disappears as the cells increase in age. The cells of the cortex in a similar manner are full of starch, which becomes disintegrated and finally disappears as the cells become permanent tissue. It is probable that this store of starch is used up during the actual penetration, which takes place at a rapid rate.

As a consequence of this difference in contents, the nucleus is yellowish and turgid in sections from spirit material, whereas the cortex is white and clear.

So much for the transverse section. Reference should be made to the tangential and longitudinal sections, figs. 6 – 12, whose lettering is the same as for that in fig. 14.

The tissues of the haustorium having been passed under review, it remains to consider the manner in which an entrance is effected into the root of the host. The means adopted are three-fold :—(1) The cells of the surface of the haustorium have the power of *dissolving the walls* of the root cells opposed to them ; (2) *Pressure* is more rarely exerted, but is evidenced by the compressed cells of the haustorium before entrance has been effected and the occasional collapsed vessels in the roots attacked, *cf. x* in fig. 15 ; (3) In large haustoria a well defined *secreting gland* is present.



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Lith: by S. C. Mondul.

The substance secreted, having the power of dissolving cell walls, is probably some *cyto-hydrolytic ferment*, and the translocation of starch grains points to the presence of a *diastatic ferment* as well. Both the epithelial cells of the gland and the epidermal cells when they are in contact with the tissues of the host show large nuclei and abundant granular protoplasm such as is met with in secreting cells.

The outer, cortical flaps of the haustorium are usually single, as drawn in the figure. Cases are not infrequent however where two flaps are present on each side one over the other, fig. 16. When this is the case we may speak of "double haustoria." The second flap h^2 arises from a great development of cells in the inner cortex on each side, and appears to be due to failure on the part of the haustorium from some cause in effecting an entrance. As far as can be gathered from the cases examined partial entrance has been made, but the lobes of the haustorium have diverged before reaching the cambium. Thus a small piece of dead bark is always to be seen at x^1. When once the cambial layer is reached a second, inner flap is not formed. Each flap formed has a well defined collapsed layer exactly similar to that in the first one. In one case met with four such superposed caps were noted.

In conclusion it may be noted that the haustoria vary a good deal in their complexity, according to the substance to which they are attached. The gland does not seem to be always present. It is of course only needed in young haustoria, but its former existence can be readily detected in older stages, *cf. y*, fig. 15. This points to a greater simplicity of the whole organ, and is chiefly met with where the root attacked is small or when the haustorium is attached to small bits of decaying leaves or bark, or the nitrogenous tubercles of *Leguminosæ*. In such cases even the tracheides are inconspicuous or absent, and the collapsed layers may even be wanting. In the haustorium mentioned above which had attacked a small chrysalis a double cortex was present, but the whole structure was extremely simple. A great mass of parenchyma was pushed into the cavity of the chrysalis, the epidermal cells of which had grown out in the manner of root-hairs.

The curious fact has been noted that the haustoria may become attached to inorganic objects such as pebbles. A number of these have been examined, and they show a series of different stages of development, short of the penetration and the formation of the tracheides. The epidermal cells, or rather those immediately beneath them, show a constant tendency to grow out after the manner of root hairs, and insert themselves into the depressions of the surface of the pebble. In one pot examined by far the largest haustorium was fixed so firmly to a big pebble that it could be swung about without becoming detached, and a well developed gland was present, *cf.* fig. 2.[1]

The numerous unattached haustoria of the sandal were thought by Scott, their discoverer in 1871, to indicate that the sandal is much less parasitic than it was formerly. But it seems to me to be quite as reasonable to deduce a developing parasitism from the clumsy and futile attempts just described, and I propose to carry this study further as time permits.

MADRAS:
29th December 1904

Explanation of the figures.

(1) A large haustorium of *Santalum album* on a *Casuarina* root

(2) A piece of *Casuarina root* much attacked by haustoria.

(2[1]) A haustorium firmly fixed to a pebble. Magnified four diameters.

(3) (4) Young haustoria cut open to show the parts before penetration. In (4) *there is a gland forming at g.*

(5) A mature haustorium open cut showing penetration.

(6) - (12) Studies of sections of haustoria in different planes under simple lens magnification The letters refer to the parts shown in figs. (13 and (14)

(6) *Transverse section,* the haustorium cut lengthwise and the attacked root across. The numbers 7 - 12 indicate the planes in which the succeeding sections are cut.

(7) *Longitudinal section,* both haustorium and root cut lengthwise.

(8)- (12) *Tangential sections* at different levels, of fig. (6). The parts will be best understood on comparing the letters with those in figs. (13 and (14.

(13) A transverse section through a haustorium on a root of *Pterospermum Heyneanum*, magnified about 40 diameters.

(14) An outline key to fig. (13).

a—e, the root attacked, *f—*[illegible] the haustorium proper, *the region* [illegible] transition from haustorium to mother root, *l* the mother root.

The root attacked. *a* vascular cylinder, *bb* cortical wings thrust aside by the penetrating process or *sucker* of the haustorium, *c* cambium, *d* cortex, *e* bark, chiefly cork.

The haustorium may be divided into *cortex f—j*, and *nucleus k—n*. In the cortex, *g* outer cortex, g^1 squashed outer protecting layer, *hh* collapsed layers separating the outer cortex from the inner, *i* lacunar tissue of inner cortex, i^1 starch-filled parenchyma, *j* epithelial layer enfolding the "wings" of the attacked root.

In the nucleus, *l* the two strands of tracheides, l^1 the absorbent portion of the haustorium directly in contact with the vascular cylinder of the host, *m* the short-lived cambium, *n* the inner part of the nucleus.

(15) A small portion of a haustorium on a root of *Casuarina equisetifolia* showing the actual contact of the absorbing cells and the vascular cylinder of the host. The part illustrated is that between the two inner $l^1 l^1$ of fig. (14) and is magnified between 400 and 500 diameters.

a woody tissues with vessels, wood parenchyma ? and medullary rays. A collapsed vessel is seen at *x* and the dark boundary line represents the position of the decomposed cambium. $l^1 l^1$ the absorbent cells, parenchyma with granular protoplasm and tracheides. At *y* in the centre the remains of the *gland* are seen. See also fig. (4) for a young stage of the gland.

(16) A "double haustorium" attacking a sandal root. h^1h^1 the collapsed layers of the first formed cortical flaps, h^2h^2 the collapsed layers afterwards formed from the inner cortex, x^1x^1 pieces of bark showing the depth to which the first penetration took place, just as *bb* shows the second and more successful attempt.

* NOTE. For much of the material used in the preparation of this paper I am indebted to Ry. Rama Rao, of the Madras Forest Department, who has the advantage of residing in a sandal tract.

ORIGINAL ARTICLES.

A WORKING PLANS BRANCH.

BY G. S. HART, I.F.S.

As must have been the case with all the recipients of the January number of the *Indian Forester*, I was very pleased to see the great improvement that has been effected in the garb of the Magazine, and I think that the Committee of Management are also to be warmly congratulated on the fact that the *Forester* has signalised its appearance in its new form with the important article on the formation of an Indian Bureau of Forestry.

The views expressed in that article that much of the sylvicultural, commercial and scientific work which should have been done has had to be neglected owing to the fact that the time and energy of the present staff are fully occupied with their executive duties, are not open to argument. Still there can be equally no doubt that much valuable work of this kind has been done, only there has been no organisation for collecting it and circulating it in a useful form, so that it has remained of very little advantage except to the compilers themselves. It is here, I think, that the Department is to blame, for probably one of the main reasons that we have no organisation of this description is that we have never taken the trouble to ask for it with sufficient insistence. However, it is never too late to mend, and for this reason I look upon the article under reference as one of the most important that has appeared in the *Indian Forester* for some time past, and I am writing these few lines in the hope that the Department generally will take up this question and show that, as a whole, they are fully sensible of the great advantages such a Bureau will give them.

For the present I propose to confine my remarks to the subject of working plans, of which I have had some little experience. Of the other subjects one is already provided for, and though I would not for one moment belittle the great importance, indeed the necessity, of organised investigation into the subjects of Forest Botany and Minor Products, or the beneficial results, financial and otherwise, that must attend such investigation, still I think that working plans are the most important branch of our work and the one of which the management under present conditions calls most urgently for revision. The future of the forest estates committed to our control depends on the plans we make for them; but how are these plans made now? In one of the largest circles in India most, if not all, of the plans turned out during the last twelve years have been compiled by the Divisional Officers with such assistance as could be given to them in the shape of the last joined recruit from Home, or a junior extra Assistant Conservator, or a Forest Ranger taken off his ordinary work, and this too mostly changing from time to time

during the compilation of the plan. Obviously really good work cannot be done under these conditions. A working plan requires the whole time and attention of the officer responsible for its production : it is not the kind of work that can be done in sections at such times as the exigencies of Divisional work permit, nor is it the kind of work on which an officer can be usefully employed, either directly in charge or as an Assistant to compile the plan under the general supervision of the Divisioned Officer, until he has had five or six years' practical experience of forest work in this country to back up the theoretical knowledge acquired during his Home training. Our sample plan, however, is completed in this way and then goes to the Conservator for scrutiny. It may be held that this should be quite sufficient, and that the addition of the Conservator's advice and assistance during the preparation of the plan should be all that is necessary to ensure its suitability. The Conservator, however, may have several plans in progress at the same time, and it may be quite impossible for him to give to each the attention it requires, or he may be new to the circle, in which case he is obliged to devote all his time to making himself acquainted with the general conditions of his charge and to getting a working knowledge of the Divisions, or perhaps he may be of opinion that there are other more important matters requiring his attention, so that it is at least possible that the Conservator's share in the plan may not be all that could be desired. Finally, our plan is countersigned by various Civil Officers, put into print and despatched to the office of the Inspector-General of Forests, where it may be passed or rejected. In the former case it goes on to the Local Government and is sanctioned, while in the latter it returns to its unfortunate compiler or his still more unfortunate successor for correction. Even, however, when finally sanctioned by the Local Government it is by no means quite certain that its provisions will be strictly adhered to for very long, for under section 88 of the Forest Code the Conservator, in conjunction with the Local Government, can do a good deal in the way of modification, so long as his action does not amount to "a revision of the general scheme of management," a somewhat elastic definition.

Now with all due deference, and perhaps some little trepidation also, I venture to hold that this is wrong. There is altogether too much chance about it. In the first place the chance that the plan will not be properly dealt with by the officers compiling it and the Conservator. Secondly the chance that it may be upset through inadequate knowledge of local conditions, and, thirdly, the chance that the provisions may be a good deal modified before they have had an opportunity of proving their suitability. To get rid of these chances we want to ensure careful consideration of the proposals between the Working Plan Officers and an officer employed on work of this kind only, for I think that most men who have had much experience of Working Plans will agree with the proposition that it is not possible for any officer, however able and experienced, to pass a really valuable opinion on a Working Plan until he has obtained a practical working knowledge of the forests concerned and of the prevailing local conditions, a knowledge which can only be obtained by a personal visit to the forests and which cannot be acquired by the perusal of any number of reports in an office. Then we want to make certain that no modifications whatever, except possibly fellings in deficit, can be made by the local officers without reference to the authority who finally approves of the plan before it is sent to the Local Government, and, finally, we want all the available information connected with Working Plans collected together and distributed periodically.

These requirements can only be met by the appointment of a special Working Plans Branch under the direct control of the Inspector-General as outlined in the article under reference. The only point on which I think exception might be taken to the proposals made in that article is in connection with the necessary staff, for it seems to me that at least three officers would be required. Surely Burma would take up the whole of one man's time, and one other officer would hardly be able to do the work in all Indian circles, excluding Bombay and Madras. One other point, a sordid one, but still one that in the present condition of the pay of the Department would have to be considered. If ever appointments of this description come into being they should be made

prizes, so that, in addition to the unquestioned honour that the appointments would carry, there should be something a little more substantial to make men work to get them. There should be no question of any appointment in the Bureau being refused by an officer on the ground that he had given hostages to fortune and could not afford to take it, as he was better off where he was.

REAFFORESTATION IN THE DECCAN AND OTHER DRY DISTRICTS.

BY H. F. ARBUTHNOT, I.F.S.

In Bellary district there are large areas, particularly in the Adoni Range, which have been included in reserves but contain no tree-growth whatever. Some of them on rich loamy soil were probably at one time under cultivation and subsequently allowed to revert to waste. They produce fairly good grass and serve as grazing grounds for the neighbouring villages. They are, however, capable of supporting forest growth, and it would be both profitable to the Department and convenient to the surrounding inhabitants, particularly in the big towns, could this forest growth be produced. At present the demand for firewood is so much ahead of the supply that it has to be met from the adjoining district Kurnool. Other bare areas are the outlying spurs of hills which have been so freely indented on for firewood and small timber by the inhabitants of the adjoining villages and so trampled down by their cattle that hardly a vestige of vegetation remains; and there is no doubt that but for severe restrictions both on grazing and on the removal of firewood and small timber these blank areas would spread at the expense of existing forest. These restrictions, especially the restriction on the removal of timber and firewood, press very hard on the villagers, who have to practise the most rigid economy to make the supply of fuel on the unreserved lands suffice. These hardships are, of course, due to the improvidence of previous generations, and the present generation must endure them; but it is incumbent on the Department to endeavour to remove these hardships for the next generation by reclothing these areas with forest.

But the question is, how? The average rainfall in the district is something under 20 inches annually, all of which falls between the second week of June and about the middle or end of October, with the exception of a few heavy showers in May. For about seven months in the year, then, there is no rain at all and struggling vegetation has to endure intense heat from the end of February to June. If planting is undertaken, the young plants must be watered for these months in their first year and at least for the hot months in their second year if they are to survive, which makes the cost of the undertaking almost prohibitive even on level ground where wells can be sunk and watercarts employed. On hilly ground planting would be impracticable. If seed is sown naturally or artificially the young seedlings cannot survive the hot weather and die off. At best the root system remains alive, and they spring up again the next rainy season, but I believe that as a rule it takes at least six years, and possibly as much as ten, before the root system is strong enough and deep enough for the plant really to begin to grow.

I believe that the solution of the difficulty can be found in the method that ryots employ in the Adoni Range for making Neem (Melia azadirachta) hedges for their fields—a method that I have never seen employed elsewhere. It is to make ridges two feet high and sow the Neem seed on the top. No trench is dug, but the ridge is made by simply scraping up the surface soil. The sowing takes place in June or July, and without any watering most surprising results are obtained. One hedge that I saw had been sown, I was told, less than two years before, and the saplings were already seven or eight feet high and eight or nine inches in girth. I sowed some Neem and Acha (Hardwickia binata), which was the only seed I had at that time, on this principle in October 1903 before the north-east monsoon was over. The Neem seed was unfortunately all eaten by rats and never germinated. The Acha seed germinated, and in the following February I dug out one of the seedlings for examination. I did my best to get the whole root system out, but after digging down as far as I could get my arm in I had to break off the two rootlets. The length of the root system which

I dug out was three feet from the column, and the root below the column was the thickness of an ordinary pencil. I then dug out one of the plants which had been planted in the neighbourhood in a pit 18 inches cube and had been regularly watered since July, when it had been planted. This I found had hardly grown at all and had a comparatively weak root system. The general appearance, too, of the seedlings sown on the mounds and unwatered was far healthier than of those which had been planted and watered.

The explanation of the vigorous growth of plants sown in this manner and of their not requiring water is, I believe, that the soft earth in which they are sown induces a very strong development of the root system and that the heap of earth retains moisture at a higher level than would ordinarily be the case. In digging out the Acha seedling I found the earth quite moist at or even slightly above ground level though there had been no rain for three months and the ground elsewhere was dry.

I went on leave shortly after this, and am therefore unable to say how these seedlings have progressed during the past year. Had I returned to the district I had intended to have tried sowing seeds of different species on mounds on some of the bare spurs of hills that I referred to at the beginning of this note and to have continued the experiment of ridge sowing on the plain areas on a larger scale. I was in charge of North Coimbatore district for a few months on my return, and made a series of ridges 18 feet apart in Sulavazi reserve of the Erode Range, the whole covering an acre of ground. The cost of the operation was only Rs. 5. I only made the ridges one foot high instead of two feet, as I wished to see how the seedlings would do on the smaller ridge. Bigger ridges would, of course, have cost more. Unfortunately it was late in the year and there was no more rain after I finished the sowing, though it was raining when I began the work and the rain had seemed likely to continue. Hence there was not enough moisture for the seed to germinate. As I am now on special duty and unable to continue the experiments, I write this note in the hope that some one else may carry them on, as this method seems likely to solve the difficult problem of reafforestation of blank areas in dry districts.

REVIEWS AND TRANSLATIONS.

REVIEW OF THE MINERAL PRODUCTION OF INDIA, 1898 – 1903.

BY T. H. HOLLAND, F.R.S.

We have been recently favoured through the courtesy of Mr. Holland, Director, Geological Survey, with a copy of his Review on Mineral Production in India. The subject is perhaps one not without interest to the Forest Officer, and we propose to give here some extracts from a Report which has proved most fascinating reading.

For the four years 1894 to 1897, a Review of the Mineral Production of India was issued annually by the Reporter on Economic Products; but in 1898 it was decided, owing to the want of uniformity in the rate of development of many minerals, to publish reviews of progress at wider intervals, covering periods sufficiently long to permit the determination of any decided secular variations in the mineral industry. The present Review, covering the period of six years, 1898 to 1903, is the first essay in this direction; but, in accordance with the orders of Government, five-year periods will be adopted for the future, and the Quinquennial Review of Mineral Production will be published in the Records of the Geological Survey of India.

In this Review the minerals are divided into two groups—

Group I.—Those for which approximately trustworthy returns are available; and

Group II.—Those regarding which definitely recurring particulars cannot be procured.

HOLLAND—MINERAL PRODUCTION, 1898–1903.

It has been possible in this report to now include the following in the first group:—Coal, Gold, Graphite, Iron-ore, Jadeite, Magnesite, Manganese-ore, Mica, Petroleum, Rubies, Salt, Saltpetre and Tin.

In the case of Gold, the most precise and elaborate details are obtainable for more than 99 per cent of the production, and approximate values are obtainable for the rest. For Graphite, accurate returns of quantity are obtained from the only company engaged in regular mining for the mineral. Although the returns sent in for the production of Jadeite and Mica are manifestly understated, both minerals are worked largely for export, and, as far as value is concerned, the export figures may be accepted as an approximate estimate of the trade in each case, whilst the nature of the error being known, the figures are not liable to be misleading. Manganese-ore has come into prominence since the older reviews were issued, and may now be transferred to Group I,

as the mineral is worked entirely for export, and the totals obtained from returns made by the District Officers agree very closely with those obtained from the ports. Rubies admit of the remarks applicable to Gold: the amount recovered other than by the Burma Ruby Mines Company may be neglected as an unimportant fraction of the total. Saltpetre and Tin are, with less certainty, entitled to places in this Group. For Saltpetre, the returns for production are evidently understated, being less each year than the quantity exported, but the export figures may be taken as only slightly less than those for the production of refined Saltpetre. The returns for Tin refer to two districts only in South Burma, but the estimates are probably more reliable than those for Iron.

This Review is directed primarily to a survey of the progress already made, and for anything approaching an idea of the material awaiting development the reader must consult the *Manual of Economic Geology*, now in course of revision by the Geological Survey Department. But besides the substances whose existence has been determined by the exploratory work to which a geological survey is properly restricted with regard to minerals of economic value the attention of prospectors might be directed to the minerals which have lately come into prominence through recent industrial developments, and which, in a country including the geological variety of India, are at present conspicuous by an absence that is probably only the result of absence of search. Amongst these are some minerals of the so-called rare metals, which, being generally of high specific gravity, should be searched for in the heavy concentrates of river gravels.

On looking over the returns for mineral production in India for the past six years, two features stand out most conspicuously. Firstly, there has been a remarkable progress in developing the few minerals which are consumed by what conveniently might be called direct processes, such as Coal, Gold, Petroleum, Gem-stones and Salt, or which are raised for simple export, such as Manganese-ore, Graphite, Saltpetre, Mica and Tin. Secondly, there has been an equally remarkable neglect of the metalliferous ores and the

minerals which are necessary to the more complicated chemical and metallurgical industries.

The principal reason for the neglect of metalliferous minerals is the fact that in modern metallurgical and chemical developments the bye-product has come to be a serious and indispensable item in the sources of profit, and the failure to utilize the bye-products necessarily involves neglect of the minerals which will not pay to work for the metal alone. Copper Sulphide ores are conspicuous examples of the kind: many of the most profitable copper mines in the world could not be worked but for the demand for sulphur in sulphuric acid manufacture, and for sulphuric acid there would be no demand but for a string of other chemical industries in which it is used. A country like India must be content, therefore, to pay the tax of imports until industries arise demanding a sufficient number of chemical products to complete an economic cycle, for chemical and metallurgical industries are essentially gregarious in their habits.

Graphite.—Amongst the minerals which have been taken up more seriously during the period under review, the Graphite of Travancore and the Magnesite of Salem in Madras are noticeable. The Graphite raised during the three years, 1901 to 1903, averaged 3,486 tons per annum, which is quite a serious item in the comparatively small market of this mineral. The total annual production of Graphite in the world varies between 70,000 and 80,000 tons, and the Indian output is thus about 4½ per cent of the total quantity raised, but its value is not returned, and is estimated at £5 a ton.

Iron.—The works at Barakar still remain as the one successful attempt to manufacture Iron along European lines in India Prospecting operations on an extensive scale have been carried on recently in the Central Provinces, the results in one area being unfavourable, and in the other undetermined. There is a general decline in the native charcoal-iron industry within range of the railways which distribute the cheap imported material, but in more remote parts of the Peninsula the old industry persists, and in parts of the Central Provinces has even improved. In the Sambalpur

District there are over 200 small direct-process furnaces still at work.

Magnesite.—Magnesite-mining was hardly established before the close of 1903, but preparations on a large scale are now being made to open up the well-known deposits near Salem, in which the mineral occurs in a condition of exceptional purity.

Manganese-ore.— The rapid rise of Manganese-ore mining is probably just now the most conspicuous feature in the mineral industry of India. Twelve years ago the industry had not definitely started, whilst last year India turned out a larger quantity of high-grade ores than any country except Russia.

Mica.—Although India is still the leading producer, and is supplying something like half the world's wants in Mica, the miner in India has not secured a satisfactorily large share of the recently increased trade in this mineral, and the returns for India show a smaller degree of expansion than those for consumption in Europe and America.

The returns of production for Mica grossly understate both quantity and value as both are below the export returns. As the only Mica on which royalty is charged is that raised in Government land, and as many Mica miners have mines in both zamindari and Government land, there are obvious reasons for understating the production, and, besides this fact, the flourishing industry of stealing Mica diminishes the returns for production without affecting the export figures.

A considerable quantity of Mica of the poorer grades is consumed in the country for ornamental and decorative purposes, and a small quantity of the larger sheets is used for painting pictures on in various parts of the country. As far as the figures for *quantity* are concerned, therefore, the exports cannot be accepted as an approximate expression of the production; but as regards *value*, the export returns may be accepted as a closer approach to the figures which should express production.

During the years 1897-98 to 1902-93, the Mica exported averaged 19,173 cwts, and had an average annual value of £77,613, or £4·05 per cwt. The variations in yearly value reflect a serious change in the trade which occurred in 1899.

In 1898 Indian Mica miners began to realise that their waste dumps contained a large supply of the material wanted for the manufacture of micanite, in which thin films of Mica are cemented together and moulded into sheets, to serve many purposes for which the natural sheets only were used formerly. The waste heaps were consequently turned over and the clear sheets of muscovite cleaned and split into thin films by gangs of children, who, by practice, could select the films of the required thickness with an accuracy which could scarcely be exceeded by the use of a micrometer The large

quantities of "flimsy" Mica thus suddenly thrown on to the market raised the weight of Mica exported, without a corresponding increase of value.

During the years under review, the two chief producers contributed to the average total as follows:—

Bengal ...	... cwt.	12,282	valued at ...	... £52,272
Madras ...	... ,,	6,872	,, ...	... £25,241

The average value out of the Mica sent out of Bengal was thus £4·26 per cwt., whilst that from Madras was £·67.

The rules for the grant of prospecting licenses and mining leases for Mica in Bengal were revised in April 1902, and are printed *in extenso* with those of Madras in the Memoir of Indian Mica published by the Geological Survey in 1902. The important changes introduced in the rules were—

(1) The levy of a royalty in the case of prospecting licenses at the rate of 5 per cent. on the sale value of Mica.

(2) The abolition of the system of putting up leases of Mica mines to auction, and provision for restricting operators to approved methods.

(3) The raising of the maximum period of leases to 30 years.

(4) The grant of power to lessees to relinquish their grants during the currency of their leases.

Of the prospecting licenses issued during the period under report, seven were granted in Nellore, four in Coimbatore, one in Godavari, and one in the Tinnevelly district, Madras Presidency. In the Central Provinces, one was granted in each of the three districts Balaghat, Hoshangabad and Chhindwara. In Burma, one license was issued for each of the two districts of Magwe and Mandalay, and two each for Myitkyina and the Ruby Mines district. In Assam, one license was granted in the Khasia and Jaintia hills. In Rajputana four licenses were granted in Ajmer-Merwara, making a total of 27 licenses, covering 3,223 square miles.

Petroleum.—The Petroleum industry has increased at a greater rate even than coal-mining, in which in the six years under review the output rose from a total of 4,066,294 tons in 1897 to 7,438,386 tons in 1903, an increase of 83 per cent. From a production of just 19 million gallons of Petroleum in 1897, the output rose to nearly 88 million gallons in 1903, and in addition to the export considerable quantities of paraffin wax, the illuminating oils and petrol refined in Burma and Assam have at last shown signs of definitely displacing foreign supplies in the Indian market.

Rubies.—During the period under review the Ruby-mining industry in Upper Burma underwent a new and favourable phase, the mineral having become, next to the petroleum, the most profitable source of revenue amongst Burmese minerals. Various leases were granted in the Ruby-bearing area near Nanyaseik in the

Myitkyina district, and the "stone-tract" of the Sagyin hills in Mandalay district, and the results have been mostly profitless; but the returns for the Mogok area, where the Burma Ruby Mines Company is paramount, show that the industry has entered a most encouraging phase. The Company was granted the right in 1889 to mine for Rubies and to levy royalties from persons working by native methods, the lease being renewed in 1896 for 14 years, at a rent of Rs. 3,15,000 a year plus a share of the profits. The results being, however, unsatisfactory from the shareholders' point of view, the rent was reduced in 1898 to Rs. 2,00,000, the share of the profits being, at the same time, raised from 20 to 30 per cent. A dividend of 5 per cent was paid for the first time in 1898, when the value of the Rubies obtained amounted to £57,950.

Tin.—Although Tin-mining in South Burma is still practised on a small scale, there has been a marked improvement in the returns, and the persistently high price of Tin is likely to inspire more enterprise in the exploitation of these deposits, which are a natural continuation of those in the Malay Peninsula, from which more than half the world's supply is obtained.

Amber.—The returns for amber show the irregularities which might be expected of an industry conducted in a casual fashion by the half-civilised inhabitants of an unadministered area. The Burmese diggings for amber are situated in the Hukong Valley in the Nangotaimaw hills near Lalaung village. The substance is found in clays of probably miocene age, and fragments of amber have been similarly found in association with beds of this age in other parts of Burma, *e.g.*, at Mantha in the Shwebo District, and on the oil-field of Yenangyat in the Pakokku District. Most of the material is brought from the Hukong Valley in Upper Burma to Mandalay, where beads of rosaries, *nadaungs* (ear-cylinders) and other trinkets for personal ornaments are made from the transparent varieties. The amber of Burma differs in chemical and physical characters from previously known varieties, and the name burmite has been consequently suggested for it. The well-known amber of Eastern Prussia contains from 2½ to 6 per cent of succinic acid, and is consequently known to the mineralogist as succinite, but the

Burmese amber contains no succinite. It is distinguished from many other amber-like resins by its superior hardness and greater toughness, which render it fit for carving and turning. Apart from the occurrence of a large percentage of discoloured and opaque pieces many of the large fragments obtained are damaged by cracks filled in with calcite; but otherwise there appears to be a large quantity of material which might be put on the market with profit. At present it is said to be unable to withstand the competition of imported Prussian amber, even in the Mandalay bazar, and the market has to a certain extent been depressed by cheaper foreign material and by an artificial substance re-made from amber chips.

Clays.—No statistics approaching completeness are obtainable to show the extent of the great industrial value of the clays in India. They include the common clays used all over the country for the manufacture of bricks, tiles and the cheaper forms of pottery; finer varieties used for glazed pottery, which in places has obtained a reputation for artistic merit; fire-clays raised in considerable quantities on some of the Gondwana coal-fields; and fuller's-earth, which is mined in the Central Provinces and in Rajputana.

Diamonds.—Notwithstanding the reputation (stretching back even as far as Ptolemy in the European, and further in the Hindu, classics) which India has held as a diamond-producing country, the output of to-day is very small and comparatively unimportant. The places which, according to accounts, have been most productive in the past form three great groups, each in association with the old unfossiliferous rocks of probably pre-Cambrian age now known as the Purana group, and distinguished locally as the Cuddapah and Kurnool systems in South India, and as the Vindhyan system in the northern part of the Peninsula.

The southern of the three groups of diamond occurrences includes localities, with apparently authentic records, in the districts of Cuddapah, Bellary, Kurnool, Kistna, and Godavari. Loose stones have been picked up on the surface of the ground, found in deposits of alluvium and in workings which have been undertaken in this so-called Banaganpilly stage of the Kurnool series of strata. In

the second group of occurrences in the Mahanadi Valley, the stones have been found in the alluvium of the Sambalpur and Chanda Districts, and though strata similar to those of the Vindhyans and Kurnools are known in this area, no diamonds have been found in these older rocks. The third group of occurrences occupies a tract some sixty miles long by ten wide, with the Vindhyan conglomerates near Panna as the centre. The diamond mining industry still persists in this area both in the old conglomerate of Vindhyan age, and in the deposits which, though described as alluvium, are possibly relics of Lameta (Upper Cretaceous) deposits.

THE NEW BOARD OF AGRICULTURE.

It will not be news to many of our readers that the Government of India have recently constituted a Board of Agriculture. The duties of this Board are, we believe, solely connected with agricultural matters; the improvement of agricultural methods by the introduction of higher quality seed grains and roots, by the adoption of up-to-date machinery and implements, by experimenting with soils and fertilising manures, and finally by the economic study of plant and animal diseases of the crops. The Board has also under consideration a system of agricultural tuition with a view to the distribution throughout the country of men trained in the science of the subject. That such a Board was greatly needed in the Empire is beyond dispute, and the good results that will ensue from its work are almost incalculable.

The first meeting of the Board took place at Pusa on January 6th and following days under the presidency of Mr. F. G. Sly, Officiating Inspector General of Agriculture, the Revenue Secretary to the Government of India, Mr. J. Wilson, C.S.I., being present as a visitor.

We have been favoured with a copy of the report of the various matters considered at the meetings, drawn up by the Secretary, Dr. E. J. Butler, Cryptogamic Botanist.

The first day was devoted to a consideration of the proposed Programmes of work of the staff of the Agricultural Department.

On the second day questions connected with irrigation, veterinary science (cross-breeding of cattle), and the extension and improvement of cotton were discussed. Cotton cultivation was also the subject dealt with on the following day. The fourth and fifth days were devoted to a consideration of the Publications to be issued by the Department, with measures to bring the Imperial experts into closer touch with the Provincial Departments of Agriculture, and the latter into closer touch with agriculturists and with agricultural education.

We congratulate the Board on their decision to publish a quarterly Journal on general agricultural subjects and in addition to issue separate Scientific Memoirs; and we trust that the day is not far distant when the Forest will be in a position to follow in the footsteps of its sister Department in this respect.

SHIKAR, TRAVEL AND NATURAL HISTORY NOTES.

ANOTHER SHIKAR INCIDENT.

About six months ago I ventured to give my views on "Shikar" literature in general whilst describing a 'curious incident.' It may be remembered that the incident was consequent on the coming of the Conservator to my Division. Strangely enough the events about to be narrated also occurred immediately following the arrival of the Conservator at the very same camp. McEluire has departed, but Snowden reigns in his stead. It will add interest to the details if I state first the moral of the story. It is this—never be certain who shot an animal until you have examined the bullets inside it. I have often seen a dispute settled in this way, but never before have I heard of the casual extraction of a bullet proving to two men, who were perfectly agreed as to the ownership of a trophy, that they were both quite mistaken.

We were seated over the breakfast table when some one rushed in to say there were "cheetal" in the compound. I went out and saw a large herd of these animals rushing across the far end of the

compound towards the forest, but on arriving at the edge, they stopped and stood gazing at the camp, presenting a grand sight with beautiful skins and swaying forest of horns. There were over a dozen stags and at least nine good heads. I stood watching them while a rifle was being put together, but as it reached me, a shot from Snowden on the other side of the house bowled over one of the herd and the rest disappeared into the forest. Unfortunately the slain animal proved to be a small stag that had pushed itself into the way at the wrong moment; the bullet, a nickel-coated expanding one from a ·400 cordite rifle, had passed clean through its neck. I went into the forest after the herd, and before long got a shot at a fine stag, with a small ·400 bore rifle firing a solid lead bullet. As I fired, the animal moved, the cover was thick, and as there was no indication to the contrary I concluded I had missed and returned to camp. On my arrival I was informed that the big stag that Snowden had aimed at had been seen to go away wounded and that a blood track had been found. Men were sent to follow the trail and I settled down to work. About two hours later I was informed by the same trackers that a wounded stag was sitting down close to the camp, and I went out with my ·450 express, thinking to polish off Snowden's stag. I came on a pool of blood within 50 yards of the elephant's camp and soon afterwards saw the stag. It immediately got up and was disappearing among dense bushes when I fired into its hindquarters and brought it down. To my surprise I found only one wound on it, and that an enormuos rent in the hindquarters. I could only conclude that my bullet had struck it in the same spot more or less as Snowden's. I informed Snowden that I had brought in his stag and went off for another stalk. On my return Snowden produced the base of a bullet which I recognised at once as my ·400 solid and remarked "I couldn't find any trace of my cordite express bullet, but here's the one you polished it off with." I stared in amazement, "but," I said, "I polished it off with my ·450 express." Then an enquiry elicited the fact, quite unknown to me, that the stag I finished off was found quite by accident and not by the blood trail, which had been lost, and that it could be none other than the stag I thought

I had missed with my first shot and the solid bullet. Snowden, hearing me declare positively that I had missed my stag and thinking that I had used my solid bullet on both occasions, was naturally as certain as I was that the stag brought in was his.

SOHELWA.

THE EROSION OF THE HILLS TO THE EAST OF THE SITTANG RIVER, BURMA.

The subjoined extracts from diaries of officers serving in the Tenasserim Circle appear to me to be of sufficient importance and general interest to be recorded in the pages of the *Indian Forester*. The hills affected are those east of the Sittang River in Lower Burma. The reservation of forests has been almost completed in the Pegu Yoma, but the hills east of the Sittang have hitherto been abandoned to the *toungya* cutter. The damage which is likely to result from this cause is foreshadowed in the passages quoted. Mr. Rorie does not advocate reservation because the *toungya* cutters have nowhere else to go. Perhaps

he has not seen the devastation caused by torrents, in the Basses Alpes for example, or in Provence, and has not read such works as those of MM. Demontzey and Surell, and so does not realise the importance of maintaining a dense covering of well-managed forest on the hills to regulate the flow of water in streams.

It has of late years been found that this is a very important matter from the point of view of irrigation, and as a source of electrical energy, permitting the development of industrial enterprises in mountainous tracts where formerly shifting cultivation and pastures were the chief, if not the only, resources of the scanty population.

In the *Revue des Eaux et Forêts* for the 1st December 1904, an article on this subject is given, as an extract from *l' Industrie electrique*, wherein waterpower is picturesquely and suggestively named "la houille blanche." This article is well worth reading. It shows that in nature there are three sorts of regulators of streams, *viz.*, glaciers, lakes, and forests. It is pointed out that the last are much more frequently met with than the other two, and that they act not only as regulators of the flow of water but condense the moisture of the air and bring about its precipitation, the rain of our land in due season, the first rain and the latter rain which is so important for agriculture.

Sometimes one meets with people in authority in Burma who question the necessity of the reservation of the forests for climatic reasons in Lower Burma, on the ground that this country enjoys an abundant and regular rainfall, and that jungle comes up again as soon as it is cut down. They seem to think that "ponzoh" (the re-growth of forest on an abandoned toungya or hill clearing) is quite as good as a completely stocked and well-tended high forest. Foresters, however, know that clean fellings should not be made on unstable hillsides subject to heavy rainfall, but that the system of "high forest" should be adopted, and the method of treatment be that known as "*jardinage*" or selection fellings. But the toungya cutter not only makes a clean felling (as nearly as possible) but also burns the cut material as completely as he can. Deep ravines are formed on these clearings during the rains,

and the silt carried down from them greatly increases the erosive action of the streams and their power of sweeping onward gravel and boulders.

I hope that the facts recorded in the diaries which I quote below will convey a hint that torrents are likely to form and the rainfall to become irregular even in Lower Burma, if care is not taken to restrict the operations of toungya cutters. It is a question of whether they should be allowed to cause devastation, ruin, and death to suddenly overtake the inhabitants of the low lands and sterilise fertile lands which pay far more revenue to the State than do their own miserable "jhums."

RANGOON: F. B. MANSON.
January 1905.

EXTRACT FROM THE DIARY OF THE DIVISIONAL FOREST OFFICER, SHWEGYIN, FROM 1ST TO 22ND AUGUST 1904.

On the night of the 7th August unprecedented floods occurred in the Shwegyin Chaung (stream), lasting till the 9th. Monster trees, chiefly whitewood and thitkado (*Cedrela serrata*) were brought down with all the bark completely peeled off. A female rhinoceros, dead, was floated to Shwegyin, as well as cattle, fish, pigs, a bear, fowls, some houses, etc. The water was thick like pea-soup. It is quite evident that some large hill or hills have slipped down. No definite information has been received yet.

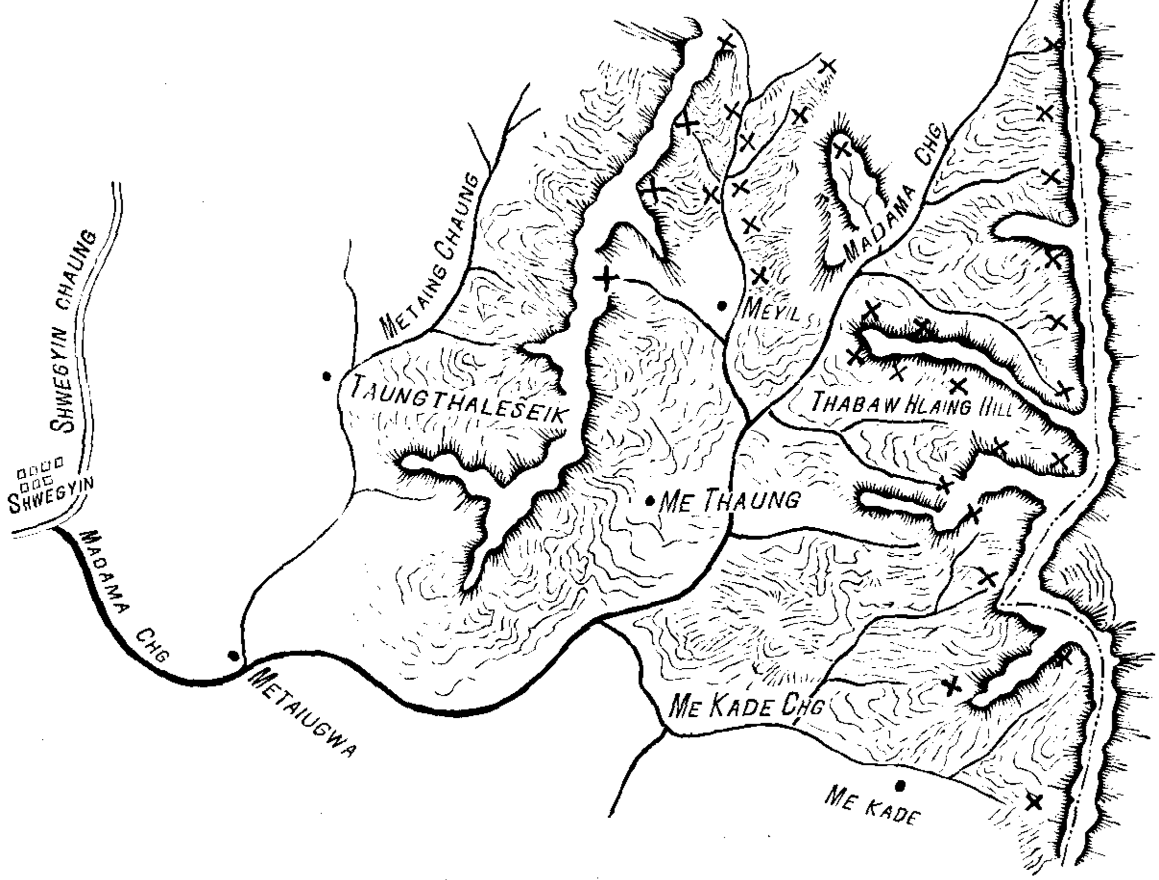
The Divisional Forest Officer was written to on the 5th October 1904 and asked to submit a report. The circle "thugyi" was sent to investigate and report. He reported to the effect that on the 10th August heavy rain at the headwaters of the Madama Chaung caused a big flood, which washed away all the houses and property on its banks. Big landslips occurred in the Thabanhlaing, Mayet, Maikah, Hteela, Maikade, Hlaypha and Hteephodoe hills. Seven houses in the Hteela village were destroyed, but no one was killed. Taungyas and gardens were destroyed and many trees, *e.g.*, Thitpyu, Taungkathit (*Erythrina stricta*), Thitkado, Kywedanyin (*Ormosia robusta*) and other species. The landslips are supposed to have been caused by the heavy rain coupled with springs which had started along the sides of the hills.

The area was visited by the Divisional Officer (Mr. Rorie) in company with the Township Officer (Mr. Shircore) early in December, as the villagers who had suffered had applied for a remission of revenue. Mr. Rorie's diary for the week ending 11th December—entry for 7th to 9th—gives a detailed description of the landslips. According to Mr. Rorie, the landslips seem to be confined to the Shwegyin River drainage (*vide* map); those in the drainage of its feeder, the Madama Chaung, are too numerous to be counted. These slips are on the steep slopes on both sides of small ravines on the sides of the hills. The soil on the highest hills is generally a white, coarse, gravelly sand with a thin covering of humus, and containing boulders of all sizes. The rock formation is granitic and of a sort which quickly disintegrates on exposure. The slips are mostly fan-shaped and usually about 30 yards wide at the base, though bigger ones were also seen. The cause of the landslips, Mr. Rorie thinks, is the heavy rain aided no doubt by taungya cutting; but in some cases slips occurred where there were no taungyas, and in others the slips started some 300 yards above the taungyas. The Karens state the rain was exceptional, and that springs appeared in many places on the hillsides. Although it is probable that many of these slips will increase in size during the next five years, the Divisional Officer does not advocate reservation as the villagers have no other land for taungya cultivation.

EXTRACT FROM THE DIARY OF W. G. COOPER, ESQ., EXTRA ASSISTANT CONSERVATOR OF FORESTS, WEST SALWEEN DIVISION, FOR THE WEEK ENDING 13TH AUGUST 1904.

10*th.*—Very heavy rain fell all night, and this morning as I was about to shift my camp to Zeebyoung, the Kyunpago Chaung began to rise. In a short while the water came over the bank in a sort of wave and continued to rise. The temporary bamboo bridge over the stream was washed away, and before long a big zayat, the forester's quarters, and some bazaar stalls were also washed away. Some of the property from these stalls was brought to the forest bungalow and kept under the house. The water continued to rise, and it was with some difficulty that I managed to take some of my things into the village; the rest had to be left in

Scale = 8 miles = 1



SKETCH MAP SHOWING ROUGHLY THE POSITIONS OF THE LANDSLIPS IN THE MADAMA DRAINAGE.

References

District Boundary -·-·-·-·-

Landslips X X X

I. I. Robin *del.*

the house. It was found that the water had risen a foot and a half inside the house. The total rise of the river was about 17 feet above the average water level. The Karens tell me that this is about the biggest flood they have ever had. The latrine and cook-house attached to the bungalow were also washed away, and some of my things drifted out of the house and were found in the jungle close by. The bazaar people lost all they had. Before the river rose so rapidly there was a distant sound of thunder or of rolling stones, and some said that there was a landslip higher up the stream.

MISCELLANEA.

PIONEERS OF INDIAN FORESTRY.

DR. HUGH CLEGHORN'S SERVICES TO INDIAN FORESTRY.

BY SIR DIETRICH BRANDIS, K.C.I.E., F.R.S.

I have read with great pleasure the notices which have lately appeared in the *Indian Forester* of the Pioneers of Indian Forestry, and it has occurred to me that some of my young friends may like to read what I wrote in 1890 (Transactions of the Royal Scottish Arboricultural Society, XII—87) regarding my late friend Dr. Cleghorn.

KEW: D. BRANDIS.
December 1904.

Since Forestry is now recognised as an important business in India; since it has become possible, by means of protection, and chiefly by means of protection against the annual ravages of fire, to convert the poor jungles of olden days into dense, well-stocked and productive forests, which yield a large and steadily increasing revenue—and mainly since experience has shown that Forest Conservancy, instead of doing harm to the people of India, promotes their well-being, and is a blessing to them and their country—the question has, naturally, often been asked and discussed, in

which part of the British Indian Empire was Forest Conservancy first started?

In the beginning of the nineteeth century the Government of Bombay established a timber agency on the western coast of the Peninsula, in order to secure a permanent supply of teak timber for the Government dockyards at Bombay. In 1847 Dr. Gibson was appointed Conservator of Forests in Bombay, and ever since that time attempts have been made, with more or less success, not only to work the Government forests of that Presidency, but also to secure their maintenance, to protect and to improve them.

Soon after Tenasserim had become British territory in 1826, repeated, but at that time mostly ineffectual, attempts were made to effect the protection of the teak forests in that Province.

In the Presidency of Madras, Mr. Conolly, the Collector of Malabar, commenced (1843) planting teak on a large scale at Nilambur, and this was the beginning of those famous plantations which have since been steadily extended by the Madras Forest Department, and which are now reported to cover 3,500 acres.*

The object of the present paper is not to decide the question whether Madras or Bombay may claim the honour of having first started Forest Conservancy in India, but to set forth the share which Dr. Cleghorn has had in this business; and hence it will be necessary to review somewhat more fully what was done in this respect in the Madras Presidency, where Dr. Cleghorn commenced his labours.

In May 1847 Captain Frederick Conyers Cotton (Major-General and Companion of the Star of India†) reported to the Government of Madras on the teak in the Anamalai Hills, and asked for the services of an officer to explore the forests. The sanction of the Government of India having been obtained to this proposal, Lieutenant James Michael (now Major-General and Companion of the Star of India) was appointed in June 1848.

* Over 1,800 acres have been added to the area of the plantations since 1890.—HON. ED.

†He died in 1901—see *Indian Forester*, XXVIII, 243

In August 1849, the Court of Directors called for reports on the results of Lieutenant Michael's work. The terms of the despatch are well worth recording, as evidence of the just views entertained at that time by the Court of Directors. They wrote: "We trust that effectual measures will be taken for its conservation (of the Anamalai Forest), so as to protect it from the serious injury which other forests have sustained."

Captain Cotton then submitted a report on the operations of felling and converting teak, the making of a road across the hills, and the settlement of the Colengode and Cochin boundaries. He also reported the number of good teak trees standing—

In the Cochin disputed territory	...	...	.	107,000 trees.
In the Colengode "	...	...	...	28,000 "
In the Government territory	...	...	...	61,700 "
		Total	...	196,700 "

Minutes were written on the subject by Mr. D. Elliot, Member of Council, and by the Governor, Sir H. Pottinger, and in February 1850 the Government sanctioned Lieutenant Michael's services being retained. In February 1851 he was sent to Moulmein to learn the methods of dealing with heavy timber, in December 1853 to the Kanara Forests, and in 1854 he was formally appointed Superintendent of the Anamalai Forests. The published reports (selections from Madras Records No. V. of 1855) deal only with timber and roads, and there is no reference to conservancy. Lieutenant Michael, however, did more than this—he brought about the lease of valuable teak forests from the Nambadi of Colengode, and he started a system of clearing teak seedlings, and young teak trees, of dry leaves and other inflammable matter in the forests, so as to protect them against injury by the annual fires of the dry season.

In 1856 Lieutenant Michael went on leave, and Captain later General Douglas Hamilton was appointed in his place. He was in charge of the Anamalai Forests for several years, and at a later date—after a regular Forest Department for the whole Presidency had been organised—Captain Hamilton was succeeded by Lieutenant (now Colonel) Beddome.

About the time that Captain Cotton first drew attention to the Anamalai Forests, Dr. Cleghorn was stationed as an Assistant Surgeon at Shimoga, in the Nuggur Division of Mysore. Being interested in botany and a keen observer, he remarked the wholesale destruction of forests in that district, chiefly through "Kumri" cultivation. It was mainly through his representations that the attention of Sir Mark Cubbon, then Commissioner of Mysore, and of Colonel Onslow, the Superintendent of the Nuggur Division of that State, was drawn to the necessity of Forest Conservancy. Dr. Cleghorn's name is mentioned in a Report on the Conservation of Forests, which the last-named officer submitted to the Commissioner in May 1847.* In consequence of this report and of Dr. Cleghorn's representations, Kumri cultivation was stopped in the greater part of Mysore and Coorg; and in 1868, while on a tour of inspection through these districts, the writer of this paper had the satisfaction of seeing large tracts of country clothed with well-stocked young forests, which had grown up on the old Kumri clearings.

In 1850, the British Association for the Advancement of Science, at their Edinburgh meeting appointed a Committee to consider the probable effects, in an economical and physical point of view, of the destruction of tropical forests. The report was drawn up by Dr. Cleghorn, and was submitted to the Association, which assembled at Ipswich in 1851. The other members of the Committee were: Professor Forbes Royle, Captain R. Baird Smith, and Captain (now Lieutenant-General) Sir Richard Strachey. The report gave an exhaustive review of the question as it then stood, and as far as it related to India, and it contributed much to induce influential members of the Government in India and at Home seriously to consider the necessity of organising systematic measures of Forest Conservancy in India.

In the Bengal Presidency it was Lord Dalhousie himself who, as Governor-General of India, carried through effective measures for the conservation of forests, chiefly in the newly-acquired Province

* Report of the Twenty-First Meeting of the British Association held at Ipswich in July 1851, p. 83.

of Pegu; while in Madras Lord Harris took steps in the same direction. In August 1856, Dr. Cleghorn submitted a report to the Government of Madras, containing proposals for establishing Forest Conservancy. These proposals were sent up to the Government of India for sanction, which was accorded in November; and on the 19th December 1856, Dr. Cleghorn was appointed Conservator of Forests in the Presidency of Madras. An account of the work accomplished during the first five years of his tenure of this appointment is contained in three general reports and other official documents, which, with other important unofficial papers, will be found in a little book entitled *Forests and Gardens of South India*, published by Dr. Cleghorn in 1861, when compelled to come home on sick leave This book has done much to promote Forest Conservancy in India. The reader must not expect to find in it the record of a complete and scientific system of forest administration, the introduction of which, under the circumstances at that time, would not have been feasible. But the record of the work accomplished by Dr. Cleghorn during this period shows that he directed his attention to such matters as called for immediate action, and that his recommendations in regard thereto were in the right direction. He justly laid great stress upon the necessity of acquiring a good knowledge of the principal trees and shrubs, as well as of the climate, soil, and forest growth in the different forest tracts; he arranged for the supply of timber, charcoal, and firewood; and in regard to the protection of the forests, he studied the chief sources of injury, indiscriminate cutting, fires, and Kumri cultivation. The result of his persistent representations was that, by an order of May 1860, the Government of Madras prohibited Kumri cultivation in Government forests without previous permission, and directed that this permission should be given sparingly, and never for spots in the timber forests. Dr. Cleghorn had thus accomplished for the Madras Presidency the same result which, thirteen years previously, he had helped to bring about in Mysore, and in both cases the result accomplished through his persistent representations has been most beneficial for the country and its inhabitants. Dr. Cleghorn was able to carry his point in

this matter, because he was known to be a true friend of the natives; he entertained feelings of warm sympathy towards them, and had made himself familiar with their mode of life and system of husbandry. As a medical man his name was widely known, and he had acquired much influence among the native population. When urging the discontinuance of Kumri cultivation in Madras as he had previously urged in Mysore, he knew that he was proposing measures which in the end would be highly beneficial for the people themselves. Dr. Cleghorn's single-minded desire to promote the welfare of the people was known to those who at that time were in influential positions in Madras, and the confidence which they placed in him was the secret of his success in this important matter.

At a later period Kumri was unfortunately again permitted in Mysore, and in Madras the beneficial effect of the order of 1860 has subsequently to a great extent been rendered nugatory by the tendency, which for some time prevailed in that Presidency, to regard as private property a large portion of the forest lands, particularly in South Kanara, that had formerly been considered to be the property of Government. These subsequent mistakes, though they have done great injury to the country and its inhabitants, do not in any way diminish Dr. Cleghorn's paramount merit in this matter. He paid great attention to a proper arrangement of cuttings, so as to secure the maintenance and promote the natural reproduction of the forests. Under his direction numerous new plantations were established, while existing plantations were maintained and extended. Establishments for the protection and proper management of the forests were organised in all districts. The time had not yet come for comprehensive forest legislation, but local rules were issued by Government on his recommendation which for the time being were sufficient.

On Dr. Cleghorn's return to India in November 1861, he was directed by the Governor-General in Council to proceed from Madras to the Punjab, in order to examine the forests in the Western Himalaya, with a view to obtain reliable information regarding the timber resources of that Province, and to institute

a systematic plan of conservancy and management. The exploration of the forests in the hills occupied the summer months of 1862 and 1863, while the winter months were devoted to the *inspection of timber depôts, brushwood tracts of the plains and* the preliminary arrangements necessary for the formation of the Department. His Report on the Forests of the Punjab and the Western Himalaya, which was published in 1864, sets forth the results of his work, and has been of great value in facilitating the organisation of forest administration in that Province and in those Native Sates of the Western Himalaya where it was possible, by means of leases, to obtain the control of the forests. His work received from the Lieutenant-Governor of the Punjab great praise, and the Governor-General in Council expressed his concurrence in the high estimation entertained by the Punjab Government of his services.

Meanwhile (in October 1862) the writer of the present paper had been summoned from Burma, where he had been in charge of the forests since January 1856, to advise the Government of India in the general organisation of Forest business. On his recommendation, Dr. Cleghorn was associated with him on the 1st January 1864, and remained in that capacity attached to the Government of India until 1st March 1865. Previously, in August 1863, these two officers had drawn up a joint memorandum, which was sent to the Government of Madras, and which urged the necessity of early demarcation of the Government and village forests in the Madras Presidency. These proposals were not, however, at that time approved by the Madras Government, and it may here be added that, in spite of the persistent representations subsequently made on the same subject by the Government of India, no adequate action was taken in Madras towards effecting a separation of the various rights and interests in the public forests and waste lands until the Madras Forest Act was passed in 1882.

In April 1866, while the writer of the present paper was on leave in Europe, Dr. Cleghorn was appointed to officiate as Inspector-General of Forests until April 1867, when the thanks of the Government of India were conveyed to Dr. Cleghorn for his

long and successful labours in the cause of Forest Conservancy in India. On his return to Madras, he resumed his work in that Presidency with his former zeal and industry. That, nevertheless, during that period much less progress was made in the forests of Madras than in those of other Provinces of the Empire was due to the views of the Government of Madras, which at that time began to manifest themselves. Dr. Cleghorn retired from the service in 1870, but has since been employed every year at the India Office as a confidential adviser to assist Her Majesty's Secretary of State in the selection of candidates for the Imperial Forest Service.

When Dr. Cleghorn laid the foundation of an effective system of Forest Conservancy in Mysore and Madras, Forestry was very little known in India. A commencement had been made in several places, but Dr. Cleghorn was the first to carry out conservancy measures on an extensive scale. His aims were large and comprehensive, but the single-minded devotion to the task which he had set himself gained the confidence of many who might otherwise have been hostile to the new measures advocated by him. A public resolution by the Government of India, of 10th January 1865,* justly designated him as the founder of Forest Conservancy in India, and added—" His long services from the first organisation of forest management in Madras have without question greatly conduced to the public good in this branch of the administration; and in the Punjab also Dr. Cleghorn's labours have prepared the way for the establishment of an efficient system of conservancy and working the forests of that Province."

Since Dr. Cleghorn's retirement from the Indian Service, he has done much for the promotion of Forestry in Great Britain, particularly through the Royal Scottish Arboricultural Society, of which he became a Member in 1865, and of which he has been President on two occasions—from 1872 to 1874, and from 1883 to 1886. It was in a great measure due to his exertions that the International Forestry Exhibition of 1884 was held with such marked success at Edinburgh.

* Parliamentary Return on Forest Conservancy, Part I, India, 1871 p. 95.

SCIENTIFIC PAPERS.

A FURTHER NOTE ON THE PRESERVATION OF BAMBOOS FROM THE ATTACKS OF THE BAMBOO BEETLES OR SHOT-BORERS.

In the Appendix Series of the *Indian Forester* [xxix—12, (1903)]* some notes were given upon the life-history of one of the minute bamboo beetles or 'shot-borers' as they have been popularly called, and the question of the preservation of the bamboo from their attacks was discussed. The effects of the latter are well known. The insects tunnel into the stem and reduce its wood-structure to powder. It is some years now since Mons. P. Lesne of the Paris Museum, at the request of the authorities of the Indian Museum in Calcutta, examined sets of specimens of these beetles sent home to him. Mons. Lesne reported that the smaller of the two beetles received was a widespread insect known as *Dinoderus minutus*, the second of the two a species unknown to Science, which he named *D. pilifrons*. Up to the year 1903 it was generally supposed that these two beetles worked in company, and that they were to be found distributed throughout India.†

Although the researches which are being instituted into the life-histories, habits and distribution of the two species are by no means complete, it has been shown in the note to which allusion has been made above that the beetle almost invariably) if not invariably, responsible for the riddling of bamboos in Calcutta (and possibly to the south throughout the Madras Presidency) is *D. minutus*, whilst its confrère *D. pilifrons* would appear to confine itself to Upper India. ‡

A series of experiments and observations were conducted at the Indian Museum throughout the greater part of the year 1903

*A note on the preservation of bamboos from the attacks of the bamboo beetle or 'shot-borer.'

†Indian Museum Notes, I, 43; III, 123; IV, 135; V, 166. Inj. Ins. Ind. For. p. 42.

‡ *Vide* Depart. Not. Ins. ech. aff. For. No. 2, 168

(as fully detailed in the note in the Appendix Series) with a view to ascertaining whether it was possible by impregnating or soaking the bamboo with some preservative material to protect it from the shot-borer's attacks. It may be mentioned that incidentally, in the course of these experiments, a large amount of information was obtained on the life-history of *D. minutus* and of the reasons which lead to its being such a pest within the area of its depredations.

The bamboos experimented with were some from a lot received at the Government Telegraph Workshops in Calcutta from Northern India. They had been cut in the cold weather of 1902-03. As already explained in the previous note, these bamboos were to be converted into field telegraph posts, and in the hope of giving them some protection against the shot-borer pest they were subjected to a series of soakings in water, copper sulphate and Rangoon oil. For over eight months untreated bamboos and those treated with one or more of the above solutions were kept under close observation, all the lengths experimented with having been received direct from the Workshops, chosen at haphazard by the Superintendent. As a result of the carefully recorded observations throughout this period it was proved that the untreated bamboos were invariably attacked by the shot-borer, *D. minutus*, within a couple of months, *i. e.*, between March and May; that soakings in water alone or water followed by immersion in the copper sulphate solution were equally innoxious to the beetles; but that those bamboos which had proceeded the stage further and had been soaked in the Rangoon oil were immune from subsequent attack by the pest. It was shown that the insect passes through no less than five generations in the year, different swarms of adult individuals appearing in April, June, July, September and October, and that the attacks of one or more of these generations with those of their resultant grubs would ordinarily have reduced the bamboos, if untreated, to powder; it was therefore held to have been proved as a result of the experiments that the life of the bamboo had been lengthened by at least a year as a direct result of the impregnation.

It has since been possible to trace the history of these treated bamboos, all of which were converted into field telegraph posts, a stage further in their career, and the evidence that has been obtained both by the use of the posts in the field and, equally important, by their storage in an open shed without any special protection being afforded to them in the Workshop yard points to the wonderful efficacy of the oil treatment. It is the purpose of this supplementary note to give publicity to this fact, firstly, owing to numerous enquiries as to the necessary treatment to be given to the bamboos, having been received from the Public Works Department, and, secondly, because the oil treatment for the preservation of bamboos may be said to have now passed the rubicon of the 'Experimental Stage' and to have reached the arena of practical utility.

To go back to the bamboos converted in 1903. Some of them were sent up that year for service with the Tibet Mission. They were returned to store in Calcutta about the beginning of the present year, and Mr. L. Truniger, C. I. E., who was in charge of the Field Telegraph with the Mission, has stated that they had fully answered expectations. Some of these returned posts were inspected by the writer in the yard at Calcutta towards the end of March last. Although it was two and a half years since they were cut in the forests of Upper India and close upon two years since they were treated with the oil, they showed no trace of attacks by the *Dinoderus* beetle. It may be contended, and justly, that throughout 1904 these posts had been at an altitude greatly above that at which either of the shot-borer beetles could, or do, live, and that they were thus safe from their attacks. This was so, but the same argument does not hold good when we come to consider those converted bamboos which remained throughout the year in store in Calcutta. An inspection of these has shown that they have remained equally immune from the pest. Most are aware how short is the life, economically, of the bamboo after it has been cut, and many know the difficulties which stand in the path of the lance, the tent-pegging and hog-spear purveyor. The results that have attended the treatment of the 9,000 bamboos in 1903 are well worthy

of the consideration of these latter, for on present observations it has been shown that the impregnation with the oil leaves the bamboo strong and serviceable two and a half years after it has been cut. Arrangements have been made to keep some of these posts under continuous observation with the object of ascertaining the longevity to which the treatment enables them to attain. That the Telegraph Department has the fullest confidence in a discovery the full credit of which chiefly belong to it, is borne out by the fact that an additional 30,000 bamboos are at the time of writing being put through the treatment and converted into field telegraph posts. It may be stated that the recommendations of the previous note are being followed, the bamboos being first soaked in water for five days (this is very necessary for reasons previously given), allowed to dry for several days, and then re-soaked in the Rangoon oil (crude petroleum), this latter, as used in the Workshops, having the consistency of treacle.

That the use of the bamboo as a field telegraph and telephone post has a great future before it has been proved by the Japanese in the present campaign. The followiug note upon the subject appeared recently in the *Pioneer** : "Every general of brigade in the field is 'at the end of a wire' which his divisional commander controls and the generals of divisions are in touch by telegraph or telephone with the corps commander. The engineers run wires after the columns with marvellous rapidity. Firing is heard somewhere at the front. A detachment of engineers emerges from headquarters, pack ponies carrying bundles of light bamboo poles, while coolies and carts follow them with coils of slender copper wire. The poles, which have pointed ends, are quickly planted, the wire spreads out as fast as men can uncoil it, and a field telephone is at work." As having a bearing upon the experiments and results attained in India, Mr. Y. Hara, Chief of the Japanese Forest Bureau, was addressed with the object of ascertaining whether the bamboo field posts used by his countrymen were subjected to any treatment. His reply would seem to show that in this matter Japan is in the position occupied by India before the discovery of the

* Allahabad, *Pioneer*, October 24th, 1904.

oil treatment. He wrote: "In answer to your enquiries with regard to a protection of our bamboos, I would state that although the method in preserving bamboos in the field is not well known, there are three processes of treatment generally adopted by our people—

(1) The season of cutting—September and October.
(2) The fumigation in sulphur.
(3) Application of both of these processes."

E. P. STEBBING.

ORIGINAL ARTICLES.

FORESTRY EDUCATION IN THE UNITED STATES.

BY G. HEWITT MYERS, M. F.

EXPERT, U. S. BUREAU OF FORESTRY.

During a recent tour of India, I have been particularly impressed by the similarity of many of its forest problems to those of the United States. It is clear to any forester visiting the two countries that in spite of the difference in the species of trees composing the forests the methods of sylviculture used in India are directly applicable to many sections of the United States. The handling of the spruce and deodar of the hills is far more instructive to the American forester who is interested in the coniferous forests of the North-Eastern States and the Western mountains than the forests of the Alps. In the same way no European forest would help the American in handling the long-leaf pine of Georgia as much as the long-leaf areas of Northern India.

It is of greater value to us to study how others have worked under conditions similar to ours at the present day than to study forests which have been under management for a century. The same is true of the work of organisation, preparation of working plans, methods of inspection and control, and fire protection. What I have said of the similarity between the problems in India and America is likewise true of forest education. The question of training officers of the superior service is specially prominent in

India at this time, on account of the abandonment of the Cooper's Hill College and the establishment of a Department of Forestry at Oxford. What is being done in America in technical education may therefore be of interest to the readers of the *Indian Forester*.

A great deal has been written in the newspapers of different countries about the enormous saw mills of America, the large scale on which lumbering operations are conducted, the immense waste through fire, the loss by timber-stealing, the injury to the forests by grazing, and so forth. An impression has thus been created that the forest conditions of the United States are as bad as any in the world. Until very recently, this charge was justified, and as yet we have made only a small beginning. But during the last ten years, the United States has made a greater advance in forestry than any other nation in double that length of time. Ten years ago, the Federal Government had a small division of forestry under the Department of Agriculture, for which an annual appropriation of some 25,000 dollars was made. This division was engaged altogether in the work of research and a propagandism. There were no Federal reserves, although several national parks had been established to preserve natural scenery in the mountains of the west. At that time there were only half a dozen trained foresters in the country; no forest schools, practically no forest literature, and relatively little public interest in the subject.

To-day the Federal reserves in addition to the national parks amount to over sixty million acres, and many million acres are under consideration for reserves. The Federal Government is now spending annually about three-quarters of a million dollars for administration, protection of reserves, and in research work.* The States individually have also begun to establish reserves, among

* Unfortunately, the forest work of the Federal Government at present is divided among three different departments, and the administration of all the public lands has always been under the general land office of the Department of the Interior. The forest reserves are therefore administered by that Department. The Geological Survey, also in the Department of the Interior, has had charge of the survey, mapping, and demarcation of the reserves, and in connection with this work has carried on reconnaissance examinations of the forest. The work of research, the study of growth, the effects of fire, and grazing, and similar scientific work, fall naturally to the scientific department of the Government, namely, the Department of Agriculture. Under this Department

Stone Cottage; one of the Buildings of the Forest School in Milford, Penn.

which is New York with $1\frac{1}{4}$ million acres, Pennsylvania with several hundred thousand acres, and other States, notably Michigan, Minnesota, Connecticut, and Massachussets, each with a nucleus for State reserves. These State reserves show the serious interest now taken in forestry in various parts of the country as these reserves have been established under the necessity of buying the lands from private owners. There is likewise a good prospect for a large Federal reserve in the Southern Appalachian Mountains which will have to be purchased at an expense of about ten million dollars. About twelve States now employ the State Forest Officers to administer the State lands and to create public sentiment. State work has been considerably retarded by the disinclination of the State Governments to adequately pay their Forest Officers and to appoint men of proper training.

There is a National Forest Association which has a rapidly increasing membership, now numbering some three thousand members, including foresters, lumbermen, owners of large estates, and game-preserves etc. In fact, the membership includes men and women of all sorts and conditions in all parts of the country who are interested in bringing before the people the great advantages which will accrue to our national welfare, if we accept the opportunity afforded by the newness of the country, to take hold of sound principles of forestry at an early period in our history. A National Congress is held annually under the auspices of the National Forestry Association at which papers are read, current questions discussed in a more or less popular way, and resolutions passed upon points that affect the proper use of forests. At this winter meeting there are invited to be present men interested in various occupations affected by forests, such as lumbering, grazing,

is the Bureau of Forestry, which is now engaged chiefly in work of research, in advising the land office in technical forest matters, in assisting private owners by personal advice, in co-operating with the several States in developing their forest policies, and so forth. This dividing up of the Federal forest work has led to great confusion and waste of energy. A strong effort is being made to consolidate under the Department of Agriculture all Federal forest work. As soon as this is accomplished the administrative service may be rapidly developed by Mr. Pinchot, Chief of the Bureau of Forestry, who has under him a strong staff of trained foresters.

irrigation, wood-pulp manufacture, mining, and so forth. Besides the regular business of the Association, one day is given up to the discussion of questions affecting each of these industries. A summer meeting is also held which is confined to forestry alone. It is expected that these conferences will be of great value in diffusing a correct knowledge of what forestry aims to accomplish and in showing the foresters themselves what opposition they will have to face. There is a Society of American Foresters whose membership is limited to those who have accomplished some work of importance to forestry. This Club's headquarters are in Washington, where bi-weekly meetings are held for the discussion of technical matters. An election to membership in this Society is a distinction, although little is known of it outside of the profession. There are also numerous State Forestry Associations whose objects are the same as those of the National Forestry Association.

The National Association has an official organ known as *Forestry and Irrigation* (formerly *The Forester*). This periodical is published quarterly at Washington and contains some articles of a technical nature, but for the most part its character is that of a popular magazine.

As in the early stages the development of forestry is still governed by the supply of trained men, officers in the Indian service will readily see how quickly, in a country like the United States, a small number of trained men is swallowed up and lost in the vast amount of work to be done and the rapid development of new branches of work. Step by step with this development and broadening of scope, a distinctly *American* profession of forestry has appeared, and it has become evident that men who have had only European training are not competent to fill the positions now opening in the United States. At the present time such men cannot pass the Civil Service Examinations for eligibility to the Bureau of Forestry without the addition of a field training in the United States. This is a very recent condition of affairs due to the rapid raising of the standard for these eligible lists, which in turn is due to the establishment of American technical forest schools.

A Corner of the Library of the Forest School.

Up to 1898 it is safe to say that the prospective forest student would have been advised on all sides to go to Europe, probably to Germany, and, what is more, to stay there from one to two years according to previous knowledge of the language, then to return to the United States and begin practical work in the Government service. At present sounder advice would be that he should first study at an American school and then go to Europe for a stay of two to five months according to the time at his disposal. As for the best country for an American to visit, this depends primarily on whether the student knows French or German. Beyond this the relative value of French and German is a point open to discussion, into which I will not enter. The point I wish to make is that in the course of the past five years the standard of forestry education has so changed in the United States that now the home school training is the essential thing and the European trip is at most only supplementary, and it seems probable that the near future will see a still further change in the same direction. Formerly, the European training was supplemented by various sorts of instruction and practise at home, and it was not until 1898 that the opening of a Forestry Department at the University of the State of New York ("Cornell") and of the Yale Forest School two years later made it possible for the prospective forester to begin his professional training at home. That home schools of forestry were demanded is sufficiently shown by the increase in the enrolment at the Yale School from seven in 1900 to sixty or more during the current year. That a home training is the best for practical work seems evident if one considers how peculiarly its own are the forest problems of any country, when viewed in the broadest sense. Of course, there are certain sciences whose principles are universally applicable, such as structural botany and morphology, mathematics, entomology and geology, and to a certain extent the art of sylviculture as well, but all these form only a fraction of what every practising forester must know. On the other hand, how can any man (and much less a boy fresh from school or college) learn in Germany the problems of transport which he must face in the United States, or learn to estimate or

"cruise" standing timber or learn to cope with the complexities of land tenure and labour problems in British India? Needless to say a foreign country is not the place to learn forest botany or the peculiarities of the people with whom he is to deal. This last point is one of vast importance in the United States; the forester must not only learn to deal with the kinds of men who will be his future superiors and subordinates, but he must also have a clear comprehension of the view-point of lumbermen, farmers, cattle-men and sheep-men, railroad managers and wealthy landowners. Most of all, why should a man who is to practise extensive, or perhaps even rudimentary, forestry learn his profession in a country where a thick population, a large peasant class, a paternal form of Government, and a long settled forest administration give the key to the instruction which he will receive and the principles which will underlie his forestry sense? How is one to learn constructive forestry in a country where forestry work is administrative routine? To be sure, much of the forestry work in the United States will eventually be administrative in the service of the Federal Government, in that of the individual States, or large corporate or private holdings. Now, however, the bulk of work lies in developing and encouraging public sentiment in favour of forestry, and in research work which shall furnish necessary data for proper administration when the country is ready for it. The extent and diversity of the necessary research work can be appreciated only by those who have a clear idea of what there is to be learnt in a large and rapidly advancing country whose forest products stand fourth in value in her entire commerce.

Instruction in forestry likewise forms a continually broadening field of work, but this instruction must differ as widely from that of the best of European schools as does the practice in a country where systematic working plans are only beginning to be known. Three kinds of schools are needed to give three separate kinds of training. First, there must be a national (not necessarily a Government) school which shall serve primarily as a feeder for the Federal service. This service in the opinion of its head, Mr. Pinchot, will, in the future, as it has in the past, make greater and greater demands for

Some of the Buildings of the Yale Forest School at Milford, Penn.

first class men. It must have men who are able and willing to do work with their hands and legs as well as with their heads. This does not mean simply that they must have a reasonable amount of nerve and endurance but also the willingness and ability to fell their own trees for stem-analysis or to cook their own food and tend their own horses, if need be. They must be men of sufficiently broad education to take up work in new branches and in new regions, to weigh future advantages and disadvantages, and to adapt themselves to conditions as they find them, unbound by any habit of stereotyped procedure, men who can use their own ingenuity to solve questions for which there is no precedent to aid them.

Second, there must soon be local schools in the different parts of the country where the forestry of the locality, as it develops, may be taught to men who cannot enter the national school.

NOTE.—Such schools have already begun to appear in more or less rudimentary forms, at the Universities of Maine, California, Nebraska, and elsewhere.

Third, there will soon be a need for a school for Forest Rangers; such a school may in many ways be compared to the one at Dehra Dun for the men of the Indian Provincial Service. It will readily be seen that of these three, what I have called a National School is the one first needed. Before speaking of the probable future development of such a school, it may be well briefly to review those which we have. I shall only mention one of the many institutions where the best of instruction may be had in the underlying sciences. At the Arnold Arboretum, a part of Harvard University, are two men whose names are well known in American forestry, Professors C. S. Sargent and J. G. Jack, and who have given their first instruction to some of the best known foresters of America.

NOTE.—In the fall of 1903 forest instruction was begun in the Under-graduate Department of Harvard University under Mr. R. T. Fisher, a graduate of the Yale School.

The Cornell School of Forestry was established as a part of the Under-graduate Department of the University of New York

at Ithaca in 1898. This school had two excellent instructors in Dr. B. E. Fernow and Mr. Filibert Roth, and gave a most useful training leading to a Bachelor's Degree in Forestry. Unfortunately, the school was dependent upon an annual appropriation from the New York State Legislature and was suspended in 1903. Dr. Fernow, its former Director, is now editing the *Forest Quarterly*, a periodical of scientific forestry, with a staff of associate editors, which includes most of the prominent foresters of the country.

Private instruction in forestry has been given since about 1897 by Dr. C. A. Schenck at Biltmore, North Carolina, on the estate of Mr. George W. Vanderbilt. The course occupies one year, including a short European tour, and, on its completion, a certificate is given. Its usefulness is vouched for by an increasing number of students.

At the present time, the Yale School of Forestry is easily the foremost in the United States. It gives the most thorough technical training requiring a Bachelor's Degree as a qualification for entrance; it is the only one on a permanent endowed basis, and is by far the largest in the country. Professor Graves, the Director, is probably the best forester in the United States, and his work in organising the school is the best thing that has been done for American forestry during the past four years. Through the generosity of Mr. Gifford Pinchot and his family, the school was opened in September 1900, as a Graduate Department of the Yale University, and began the year with Professor Graves and Assistant Professor Toumey as instructors in technical subjects, with the regular University facilities as auxiliaries, including such well-known scientists as Professor William J. Brewer. The students numbered seven during the first year, and the writer counts it a great honour to have been one of them. For this reason some allowance may be made by the reader for the following account of what the school has accomplished and hopes to do in the future.

At present there are 30 odd students in each of the two classes. During the four years of the school's existence, the faculty has had to face the above formidable increase in enrolment and a fire which necessitated the re-modelling of the building set apart by the

Wood-Testing Laboratory of the Forest School.

University for the school's use. In spite of these things, however, the course has continually improved. There are two distinct bases for instruction—one in New Haven, where the University is located, and where the principal part of the laboratory and class-room work is conducted; the other at Milford, Pennsylvania, in a region well known for its white pine and hardwood timber. Here a considerable part of the forest work is carried on: each plant is provided with lecture halls, library, reading-rooms, laboratories and so forth. The accompanying photographs will give an idea of the buildings and some of the rooms. As this is essentially a professional training school, no student is admitted unless he has already received at some high grade collegiate institution a liberal education, including the study of mathematics, language, and natural science. The courses at Yale are, therefore, of a technical character. The graduates are often called upon to undertake work of great responsibility immediately upon leaving the school. For example, several have received offers to teach in colleges giving courses in forestry. One has been sent to the Hawaiian Islands to take entire charge of the insular forests; others have taken responsible commissions in charge of private estates. In nearly every case the graduates have at once taken up work which they could not have done without a thorough general education. The entering class meets at Milford in July, and spends ten weeks in camp doing forest work with Professor Graves. Each morning the students meet for one or two hours of lectures, and the rest of the day is then spent in the forest. The students learn first to identify the trees impirically, the theoretical work of forest botany being taught later at New Haven. Thus consistently with the whole course of instruction, the student is taught to know something of the trees as they grow in the forest before he is asked to study their botanical and sylvicultural character from text-books. The remainder of the summer term is occupied mainly in the study of sylviculture and forest mensuration. These subjects are likewise taught less from text-books than in the forest itself. One of the first tasks of the student is to learn to fell a tree properly and to cut it into logs, so as to yield

the greatest measure of boards or other products. Each student is required to make stem-analyses of seventy-five to one hundred trees, and to determine their contents; to construct tables of value, and form-factors; to make a study of the rate of growth of a given species in diameter, height, and volume and to construct yield-tables. He is not merely told how to estimate timber and study growth, but is required to do the work for himself. In botany, the student must be able to identify trees in the forest both in winter and in summer; in geology, he must identify rocks in the field and make soil maps. In engineering he learns to make topographic maps with the transit and other instruments, and also does quick map work, such as is done by Army Engineers. He must be able to lay out roads and trails; his knowledge of lumbering is based on three weeks spent in a lumber camp in December of the senior year, and he is then required to make a complete report upon the methods in use in the region in which he has chosen to spend his time. In addition to this, most of the students spend the summer vacation at the end of the junior year in field work for the Government. During the course, complete working plans are made by small groups of students and hundreds of trees are planted by each of them. Practise in thinnings, reproduction cuttings and other sylvicultural operations are made upon the lands of several city water companies who have placed their forests under the management of the school. Space does not permit a further description of the actual curriculum, but enough has been said to show that the underlying principle of instruction is in direct contrast to the method of long text-book work in theories and principles at the beginning of the course. Theory and principle must indeed be learnt, but it is believed at Yale that if they are taught first they cannot be sufficiently closely connected with actual forest work to make them of use to the student. Future changes in the course will probably be consistently in the direction of confining the work of the two years' course still more strictly to technical forestry. Less and less of the time will be taken up with teaching such subjects as microscopic botany, entomology, zoology, geology, and so forth, as it becomes possible to demand in entrance

Part of the Summer Camp of the Yale Forest School, Milford, Penn.

requirements more and more of these subjects which can be obtained in collegiate courses. At the beginning of the school, such severe demands could not be made in requirements for admission, but the policy of the school is to take only those men who have already had the greatest possible amount of fundamental work, so that their entire two years at Yale may be free for practice in such work as they will afterwards be called upon to do.

THE HALIYAL TIMBER DEPOT.

BY W. A. TALBOT, I.F.S.

Bombay Forest Officers, retired and in active service, as well as many readers of the *Indian Forester* will be interested to learn that the well-known Haliyal Timber Depôt in North Kanara has been abolished. The last sale of teak and jungle wood was held there a few weeks ago. The whole of the stock of timber was disposed of to the usual purchasers at excellent rates. Nearly three lakhs of rupees were realized. In future the annual auction sale of teak exploited from the fine high timber organized forests of Supa in North Kanara will be held at Tawargatti on the Southern Mahratta Railway line between Dharwar and Belgaum, where a new depôt with buildings has been formed. The advantages of this location are a considerably reduced lead from the forest blocks to be worked during the next 16 years, and the Railway sidings being in the depôt itself, logs can be loaded in consequence directly on the wagons. It will be remembered that Haliyal was seven miles distant from Alnawar, the nearest station on the Southern Mahratta Railway, and the timber had to be carted that distance and again reloaded on the trucks. Haliyal has, however, the distinct advantage of being the centre of a well-established timber trade and has facilities for purchasers which the new location does not possess.

The Haliyal timber depôt was established in 1865 by Colonel W. Peyton (then Captain Peyton), a famous sportsman and excellent forester Conservator of the Southern Circle, Bombay Presidency, for the storage and sale of teak and other kinds of

timber, cut in the Supa division of North Kanara. Each year one to two lakhs of rupees worth of wood were disposed of, principally to traders from Belgaum, Hubli and Dharwar. This material was afterwards retailed to people usually resident in the Southern Mahratta country. But as the fame of the excellent quality of the Kanara teak and the fine condition of the logs was widespread the wood has frequently been exported to many places far outside the southern parts of India. The logs are squared with the axe in the forests and are dragged part of the way from the forests by buffaloes or carted directly to the depôt. No elephants being used in the exploitation of these Supa forests the logs are never of very large scantling. When the trees are in easily accessible places the contractors sometimes bring in pieces of over two tons. The general average size of logs is about 3 khandies or three-fourth ton each. The price of teak has been steadily advancing of late years, and as railway and mining companies are extensive purchasers the bidding at the auctions is usually animated. Rupees 80 a ton of 50 cub. ft. was the average of the last teak sale. This rate was, however, only about half of that obtained some time after the great American Civil War. At that (1866) sale teak logs fetched as much as Rs. 180 a ton. The ryots were well off in those days. Colonel Peyton used to relate how a purchaser at this sale arrived in the depôt carrying a heavy bag of rupees on his back. After walking about and selecting his requirements he went up to Captain Peyton and throwing down his load of rupees with a sigh of relief said "Saheb, I have selected such and such logs; take what you want and give me back the remainder"—" Bancheso dev." The Southern Mahratta ryots waxed rich in those days over the sale of their valuable cotton. They were, however, usually thriftless, some of them going so far as to fit their common cart wheels with silver tyres. The period of prosperity soon turned into one of adversity, and many of these same ryots, who did not know how to spend their money a few years before, died miserably of starvation during the great famine of 1876-77. There were no sales of Kanara timber at Haliyal during those years, and the effects of this famine period influenced adversely the value of timber for a

long time afterwards. Of late, however, the price of teak has greatly advanced. Several of the large Railway Companies, Great Indian Peninsular, Southern Mahratta, etc., have become large purchasers of Haliyal teak, and as the supply is strictly limited by the conditions of the working plan, the increased demand for a limited quantity of material has considerably enhanced the market rate of teak.

The differences and merits of the two kinds of teak timber, *viz.*, Malabar or Kanara and Burma or Moulmein, are well known to the readers of the *Indian Forester*. Haliyal was the chief depôt in Bombay, Western India, for the sale of the former, and as such a notice of its abolishment was likely to prove of interest. The future of the new establishment at Tawargatti will be carefully watched by Bombay foresters and others interested in the timber trade of North Kanara.

THE TOPOGRAPHY OF BRITISH INDIA.

India. By Col. Sir T. H. Holdich, K.C.M.G., K.C.I.E., C.B., R.E. With eight coloured maps. *The Regions of the World.* Edited by H. J. Mackinder (London : Henry Frowde, Oxford University Press. Price 7s. 6d. net).

Sir Thomas Holdich is too well known in India to render any introduction of the author of this book necessary. The work forms one of a series entitled *The Regions of the World*, edited by

Mr. Mackinder of which *Britain and the British Isles*, *Central Europe*, *The Nearer East*, and *North America* have already appeared. *The Far East*, which should prove of as great interest to Anglo-Indians as the volume under review, is in the press.

In his short preface Colonel Holdich informs us that he was carefully warned against the inclusion of statistics and details, and he has therefore chiefly relied on descriptive methods of treating the infinite variety of the geographical configuration and the geographical distributions of India. British India and Burma together occupy 905,000 square miles of the Continent of Asia and the Native States and Dependencies of India absorb 611,000 more. This is exclusive of Baluchistan (130,000 square miles). The total population of this area amounted to 231,000,000 by the census of 1901, or about 15 per cent of the entire population of the world.

With climates varying from the ice-bound deserts of the higher Himalayas and the rain-steeped forests of Tenasserim to the barren desolation of Makran, where at one time of the year fire is almost unnecessary, even for cooking, and at another the cold blasts almost render human habitation impossible; with inhabitants who number races unsurpassed as brave and fierce fighters and races among whom cowardice is regarded as no disgrace; with customs, laws, literature and arts essentially at variance with Western notions in these matters—such is India, a name merely or rather a geographical expression for the territories administered by the Indian Government. To describe such a country within the limits of a book of moderate compass required a masterhand, and such has been found in the author.

The Indian Empire is composed of two parts, each of which may be regarded as a geographical unit, and each geographically distinct from the other. The larger and more important of the two may be regarded as India proper, and consists of the alluvial plains of the Indo-Gangetic river system and the triangular area known as the Peninsula. It is cut off from Burma by a tract of mountains impassable by reason of the deep-cut network of

valleys and the dense vegetation with which their slopes are covered, and on the north it is bounded by the mighty range of the Himalayas. Both these barriers have proved effective against either ethnical or military invasion, but on the west are the semi-desert hills and open plains of Afghanistan and Baluchistan, which have been repeatedly traversed by invaders. It was across this region that came, not only the great prehistoric Dravidian and the semi-historic Aryan invasions of India, but also the military invasions of Alexander the Great and of the successive Mahomedan conquerors of India. Until the improvement of navigation brought in the nations of the West it was the only route by which invasion and conquest was possible.

The historical invasions from Alexander downwards have been purely military: they have left their impress more or less deeply marked on the religion, the administration and political geography of India in buildings and public works, but they have hardly affected the great bulk of the people who derive their origin from the earlier invasions.

The other unit of the Indian Empire is Burma, which belongs geographically rather to Indo-China than to India. Cut off from the latter by a band of forest-clad mountains, which has rarely been traversed, it received centuries ago its religion and philosophy from India, but has remained unaffected in all other respects, and maintained its ethnical distinction untouched. This isolation is now at an end, and the gay, picturesque, pleasure-loving Burman, who had evolved an epicurian philosophy and regarded life merely as something to be enjoyed, is being ousted by the plodding unattractive native of Bengal and Madras.

Across the north of the Empire runs the great mountain barrier of the Himalayas, the highest and greatest mountain range in the world, which separates the Mongolians of Tibet from the races of India, and has left its impress on their mythology and folklore. This is given a chapter to itself, but the author abstains from formulating any theory of the Himalayas.

On the subject of Afghanistan it is worthy of note that the author consider, that the country will in the future have to look to

its forests and resources in silk, camel-hair clothing and wool for further financial development, since every available acre is already cultivated. We trust, should this be the case, that the Amir will be guided in the management of his forests by the opinions of trained experts rather than by those of the lumberer, for the advent of the latter into a country like Afghanistan would be disastrous.

To all interested in the study of the Fauna and Flora of India or in its geographical peculiarities we can confidently recommend this fascinating book, perhaps not the least interesting portions of which are its excellent maps.

A TURPENTINE CONCESSION IN BRITISH HONDURAS.

A correspondent has very kindly forwarded the following translation of a note in the *Revue des Eaux et Forêts* of 15th February 1905, which is itself a translation from the English *Board of Trade Journal*: –

British Honduras Concession of Turpentine.—According to an agreement between the Governor of British Honduras and an American this latter, in return for the privilege of collecting the turpentine of 12,500,000 pines, engages to pay one cent per pine. For the concession, which is granted for 26 years, 125,000 dollars are to be paid within two years from now.

According to the terms of the agreement all the products of the pines obtained by the grantee will be exempted from all export dues, and the material and tools necessary for cutting or tapping the pines and for the manufacture and transport of the products of the pines will be admitted free from importation dues.

On this subject the United States Consul at Belize reports that the exploitation of the pine forests of British Honduras will necessitate large purchases of machinery and of food for several years. Nearly one-third of the Colony is covered with pines, and, although the trees are not of large size, the wood is very hard and rich in sap.

The concession has been given especially with a view to the manufacture of the turpentine and to the exportation of the timber, but the industries (*entreprises*) which it will develop as a consequence will not be limited to these projects alone.

Tramways, permanent roads, and the development of agriculture will certainly follow, and the utilisation of the unexplored lands of the Colony will be effected, or at least greatly encouraged.

The writer in the *Revue des Eaux et Forêts* adds the following remark of his own :—

The Governor of British Honduras appears to us to have chosen a rapid and certain method of ruining the forests and the Colony.

SHIKAR, TRAVEL AND NATURAL HISTORY NOTES.

TWO NEW INDIAN RUMINANTS.

SPORTSMEN will be interested to learn that two important additions have recently been made to the big game fauna of the Indian Empire. A short time ago that well-known Burmese sportsman, Captain Evans of the Veterinary Department, sent home to the British Museum the skins of two gorals from the interior of Upper Burma, which, on examination, proved to indicate a perfectly distinct species. For this species an appropriate name has been selected. That the Burmese goral would turn out to be an undescribed form has long been expected, but the one specimen previously received in England was insufficient to determine this point with any approach to certainty. The animal is a brownish grey species, without any distinct dark dorsal stripe or dark streak down the front of the legs, and with a yellowish throat-patch. While examining the skins of Himalayan gorals in the collection of the British Museum for the purpose of determining the Burmese species, an altogether surprising and totally unexpected discovery was made, namely, that there are two

perfectly distinct kinds of goral in the Himalayas. In several books on Himalayan sport, such as the late General McIntyre's "Hindu-Koh," the Himalayan goral is described as a grey animal with a large white patch on the throat and sides of the face; and an animal of this type, from Chamba, is now living in the London Zoological Gardens, where it is labelled as being the true goral, *Urotragus* (or *Cemas*) *goral*. A similar specimen, presented by the Duke of Bedford, is exhibited in the British Museum.

On turning, however, to Blanford's "Mammals of British India," we find the goral described as a brownish ruminant (with a tendency to grey) characterised by the presence of distinct blackish dorsal stripe and of dark stripes down the front of the legs, as well as by the possession of a white throat-patch. Skins collected by Brian Hodgson in the Nepal district agree in all respects with this description. One example in the same series (in the British Museum) is, however, of the above mentioned grey type, and has apparently been regarded as indicating a colour-phase or immature example of the typical species. It was probably this specimen which induced Dr. Blanford to state that the ordinary Himalayan goral exhibits a tendency to greyness.

The grey goral, as the new species may be called, differs from the typical brown goral not only by its light grey colour mingled with black, but by the circumstance that the pure white patch on the throat extends on to the sides of the face, by the absence of a distinct dorsal stripe, and by the forelegs having a dark knee-cap, but being elsewhere of the same hue as the body, instead of with a continuous dark stripe down the entire front surface.

The Chamba specimen living in the London Zoological Gardens, together with the mention of grey as the colour of the animal by General McIntyre, indicates that the grey goral is the representative of the genus in the Western Himalayas. The brown, or typical, goral, on the other hand, as indicated by the specimens collected by Brian Hodgson in Nepal, is doubtless a native of the damper and hotter districts of the Eastern Himalayas; animals inhabiting countries of the latter type being

generally of a darker tone of colour than their relatives from drier, cooler, and more open districts.

Information as to the precise ranges of these two Himalayan gorals is, however, much needed; and this can be supplied only by sportsmen and collectors in India. The occurrence of a specimen of the grey goral in the Hodgson collection may probably be taken as an indication that this species (as well as the brown goral) is found in some part of Nepal or the adjacent districts of the Himalayas. Possibly the brown species may inhabit the damp Terai area, while the grey species is confined to the drier zone immediately above. It has, however, still to be determined whether the brown goral is really a forest species, for in Chamba and Kashmir goral are, I believe, found in grass country dotted over with low bushes rather than in forest. The matter may be commended to the best attention of sportsmen, more especially those who have the opportunity of shooting in the Terai district. A good skin of the brown goral would be very welcome at the British Museum for exhibition purposes. Captain Evans is to be congratulated on obtaining the specimens which led incidentally to the addition of two species to the Indo-Burmese fauna.

R. LYDEKKER, in the *Indian Field.*

THE CLOSE SEASON FOR JUNGLE HENS IN THE NILGIRIS.*

The Committee of the Nilgiri Game Association recently approached the Revenue Board with a proposal that the close season for jungle hens, which at present commences on 1st January, should in future begin on the 15th December. The alteration was recommended because it has been found by experience that jungle fowl begin breeding before the end of December and that considerable damage is caused by the shooting of hens during the latter half of that month. For the reason stated the proposed

* From papers kindly placed at the disposal of the Hon. Editor by the Government of Fort St. George.

alteration was recommended. The Board after a consideration of he case supported the Game Association's proposal, the Government being asked to substitute 15th December for the 1st January in Rule 3 of the Nilgiri Game Rules.

In their reply Government stated that they were unwilling to accept the proposal of the Nilgiri Game Association, which would involve the prohibiting of the shooting of jungle fowl during the Christmas holidays, and created a close season of nine months throughout the whole of the Nilgiris. In their decision they quoted chapter and verse from Blanford (Faun. Br. Ind. *Birds*, iv, 85) "the time of breeding (for jungle fowl) varies: March and April on the Eastern side of the Nilgiris, October to December on the Western, but generally from March to July." This would make the proposed open season the breeding time as far as the Western Nilgiris are concerned.

The Board was requested to ask the Game Association to consider the question further and to report whether a shorter and different close season should not be prescribed for the two sides of the district.

It seems a pity that the Game Association did not reply direct to this question of Government, for it would have afforded some very interesting practical information. No one, and we are sure Dr. Blandford would himself be the very last, pretends that we understand all about the habits of the greater number of our game birds in India, and here we have a case in point, for there appears to be a considerable divergence of opinion as to the breeding season of even such a familiar game bird as the jungle fowl. The Game Association replied as follows to the Government question :—

The Committee beg to point out that the proposal does not involve the prohibition of shooting *jungle fowl*, but only of jungle hens, which require special protection during this period. Jungle cocks can be shot up to the 15th March.

The experience of a large number of the Committee is that the breeding season of jungle fowl throughout the Nilgris does commence before the end of December and continues during the

spring months. The Committee again recommend the proposed alteration.

The Board again referred the matter to the Association for an answer to the Government question, and obtained the opinion that 'there should not be a different close season for the two sides of the district nor does it consider that the breeding season begins in October in any part of the district.'

The Government reply was that it did not see any sufficient reason for altering the existing close season. We regret that in the interests of the bird the Game Association did not take the trouble to substantiate their case. To merely make a statement without bringing forward a particle of evidence, especially when the case is one easily ascertainable and of interest to sportsman, naturalist and scientist alike, is scarcely the procedure one would look for from an enlightened body such as the Nilgiri Game Association. We trust that it will endeavour to impress in a more satisfactory manner upon its members the fact that the bird does commence breeding in the latter part of December, and that the hens are consequently no longer 'game.'

EXTRACTS FROM OFFICIAL PAPERS.

A FOREST TRAINING SCHOOL IN MADRAS.*

IT was suggested in Madras some years back that a school should be established at some central place for the training of the lower subordinates of the Forest Department. This proposal was made by Mr. Gass, Conservator of Forests, Southern Circle. In 1902 Mr. Gass again strongly urged the necessity of establishing a school in the Presidency for the training of Deputy Rangers, Foresters and Guards, and proposed that the school should be located at Coimbatore. The Board recognised the importance of elaborating a scheme for instructing Forest subordinates in special forest works and for instilling into them a greater pride and interest

* From papers courteously placed at the disposal of the Hon. Editor.

in their profession. It accordingly requested the Conservators to consider and settle the preliminary question as to what class or classes of subordinates are most in need of the improvement which such a training would afford.

After consideration of the Conservators' replies to this reference, the Board accepted their unanimous opinion that the training should be confined mainly to Guards and Foresters, but since it was impossible to expect men of the class from which Guards are appointed to voluntarily proceed for their education to a central school, established at a distance from their homes, the Board considered it advisable that one or two schools should be instituted in each circle instead of one for the whole Presidency as suggested by Mr. Gass. Proposals were accordingly called for as to sites, teaching staff, curriculum of studies, etc., for the proposed schools. These replies were carefully considered by the Board and were also discussed individually with the Conservators, and the conclusion was arrived at that one school for the training of Guards and Foresters should be established as an initial experiment in each circle on the following lines :—

(1) The training to be in the vernacular and confined to practical field work.

(2) The number of men to be trained not to exceed 20 or 25 for each circle.

(3) Two courses of training of three months each to be instituted, one more advanced than the other, to be taken successively with an interval of a year between.

(4) The instruction to be given by an officer by example as well as precept.

(5) The Instructors to consist of an Extra Assistant Conservator and a Ranger or a Ranger and Deputy Ranger.

(6) There should be three separate classes in each school, one for Guards (easy), one for Guards (advanced) and a third for Foresters.

(7) The instruction to be entirely in the forest.

(8) The Guards to be given a small addition of pay when they have satisfactorily passed through the two classes.

The Board in submitting these proposals laid particular stress upon the fact that a better trained set of Forest Guards and Foresters would be urgently needed if the works of improvement and exploitation which the Department must shortly undertake as forest organisation develops are to be successfully carried out. It would also be necessary to provide promotion for such men as an inducement for them to work hard and be honest. With this object the Board considered that in accordance with the opinions expressed by the Conservators, Foresters should be recruited mainly from the class of Guards; while the Guards should be recruited mainly, but not entirely, from the local jungle or village class who are accustomed to rough outdoor life, and not from the class of semi-educated sedentary towns men who are not accustomed to such life, and who frequently take up such appointments merely because of their unauthorised emoluments. Guards and Foresters should be men who can really be trusted to do the work expected of them and to carry out the orders issued, not men who have their heads full of undigested and theoretical book knowledge and are incapable of doing practical work. For the above reasons the Board was strongly of opinion that a practical outdoor course of training in forest works (as distinguished from a school course) should be prescribed for Foresters and Guards in order to fit them for their duties.

After calling for further information as to the probable cost of the scheme and to the nature of the instruction it was proposed to impart to the men the Government issued orders in the matter. They recognised that in spite of the severe disciplinary measures (what these were, why needed or how they were to improve the staff is not stated) adopted in late years, the efficiency of the protective staff of the Department still left much to be desired, and they agreed with the Board that with the completion of the process of afforestation better men will be required to carry out the more specialised work Whilst welcoming the proposal they however doubted whether the general education of the class of men from whom Forest Guards are recruited is sufficient to enable them to profit by the instruction which it is proposed to impart at the training

school; and they therefore consider that it would be advisable to exclude Guards from the scheme. The Department must look to the Ranger, Deputy Rangers and Foresters to get work from the Guards and keep them in discipline. On the other hand the class of Deputy Rangers, as at present constituted, includes many men with little training to fit them for the duties of their appointment; and it would be very desirable that such as have not had the benefit of training in the Forest School at Dehra Dun, nor are ever likely to be deputed there for want of the requisite qualifications, should undergo the proposed course of instruction along with the Foresters, unless they are over an age to be taught or are otherwise unfit.

Proceeding on the above basis the Government modify the scheme as indicated by the Board as follows :—

(1) There should be only one school, situated in some suitable central site in the neighbourhood of typical educational forests.

(2) The school to be conducted by an Extra Assistant Conservator of Forests assisted by a Ranger, subject to the orders of the Conservator of Forests.

(3) The school to be open to Deputy Rangers and Foresters and at their own expense to candidates selected for these appointments. Thirty-five years to be the limit of age. Subordinates holding the Dehra Dun certificate or who are likely to go there not to go to the local school.

(4) Course of instruction to extend over six months and two courses to be held in the year. There to be only one class consisting of ordinarily not more than twenty pupils.

(5) The curriculum to include—Elementary surveying, demarcation, fire protection, supervision and execution of works, elementary sylviculture, drill and care of uniform. No attempts to be made to teach botany or any of the scientific aspects of forestry nor anything not common to the whole Presidency. Finally, the teaching to be in English.

Provision was made for starting the school from the beginning of the next official year (April 1905).

Whilst we are of opinion that the idea of the local school is a most excellent one we regret that the Government should have so modified the Board's original proposals as to greatly decrease the power for good of the new departure. Looking back we see that the original proposal was that the training should be given to Guards and Foresters. They come at the bottom of the Provincial Establishment. At the other end we have the Extra Deputy, Extra Assistant and the Ranger. Their training is provided for at the Dehra Dun Forest School. This leaves in between the Deputy Ranger. It is open to all these latter to go to Dehra, and it may be taken for granted that all the good men will, and do, do so. What is left? It is to teach the residue that the Board's enlightened attempts to improve the lower ranks have been upset. It cannot be advanced that these Deputy Rangers are prevented from attending the vernacular class at Dehra owing to a want of knowledge of Hindustani since the present proposal institutes English as the language of the new school. It is not therefore to teach the non-English-speaking Deputy Rangers, and in Madras these in all probability do not exist We think that the deputation of these Deputy Rangers to attend the Foresters class at the Board's proposed school would have fully met the case. We cannot agree that the idea of educating the Forest Guards is an impossible one. The training proposed was an eminently practical one, and the sooner a Guard who could not have followed it was got rid of the better for the Department. It is considered quite possible to teach the ryot improved methods of agriculture and the use of better implements. Equally possible is it to teach the Forest Guard a practical knowledge of the work he is required to do, and his use in the forest would be increased thereby a hundredfold. Most Divisional Officers could tell how quickly their own personal peons, Ranger's peons, &c., pick up the forest work. The great essential is that they should be *shown* how to do things.

The Government's decision to constitute one central school instead of three we are inclined to agree with. Experience has always to be gained in these matters, and it is better to make mistakes in one rather than in three places at once. We would

suggest however that the Extra Assistant Conservator in charge should be placed under the Divisional Forest Officer of the division in which the school is located, the latter being directly responsible to the Conservator, since a number of questions and references, etc., will quickly crop up which will require a mature experience to decide upon.

As regards the curriculum the practical course in the forests would have been more useful. The present one has every appearance of being a poor modified adaptation of a portion of the Dehra School course and, in the time available, it could be little else. Contrary to the Board's proposals we should have advocated a six months' course to be spent entirely on practical work in the forest with a practical examination at the end of it. We do not think that the written certificate of the officer in charge would be quite a sufficient guarantee that a student had really assimilated what he had been taught.

H. C. Robinson, Photo.

Palaquium Forest in Federated Malay States in which the undergrowth has been cut back to set free the Palaquium gutta saplings.

VOLUME XXXI NUMBER 6

INDIAN FORESTER

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THE PROHIBITION OF GRASS BURNING AND ITS EFFECT ON THE GAME OF THE COUNTRY.

"Sahib! you are steadily driving us from our home on these hills. Why is the grass never fired now and why left to die down season after season, till it cumbers the earth with such a mildewed and powdery carpeting as none but the rankest herbage may penetrate when the rain comes down? The bison are going and we follow, and at no distant time these hills will stand yet more desolate, deprived of all that once gladdened their solitude." (Leaves from an Indian Jungle.—*The Autobiography of a Sambhar Stag.*)

Some most interesting papers have recently been issued with reference to the former annual burning of the grass on the grazing grounds of the Nilgiri plateau, its recent prohibition, and the resultant effect upon the herbivorous animals of the plateau. The subject in its bearing upon the distribution and preservation of the game, not merely of the herbivora alone but of the carnivora as well, throughout the country is one of considerable interest; but whilst of interest it is also of such importance, alike to the sportsman, the zoologist and the public generally, for the civilised community has set its face against any further extinction, in as far as lays within its power to prevent it, of any of the species at present inhabiting the globe, that its consideration in these pages needs no apology.

PRESENT POSITION IN THE NILGIRIS.

Briefly the position in the Nilgiris is as follows:—The Todas have, from time immemorial, annually fired the grazing grounds of the plateau during the hot weather in order to obtain a crop of fine young grass with the first rains. Apparently as long ago as 1879 the then Commissioner framed rules rendering this practice illegal, but the rules have remained in abeyance until within the last year or so, when they were enforced. This resulted in a petition from the Todas to the Collector, stating

that the prohibition was having a disastrous effect upon their cattle. The matter was then gone thoroughly into, and in order that all parties should have a hearing the District Forest Officer, in his note to the Collector on the subject, suggested that the "Nilgiri Game Association" should be requested to give their views on the question. This suggestion was supported by the Board, and the views thus obtained are of sufficient interest to warrant their further consideration.

IMMEMORIAL CUSTOM OF FIRING GRAZING LANDS IN OTHER PARTS OF INDIA.

As is well known, this firing of grazing areas has been the immemorial custom all over the country, one might almost say throughout the world, wherever the wealth of a community has chiefly reposed in its herds of cattle.

PROHIBITION OF FIRING IN FOREST RESERVES AND OTHER PROTECTED AREAS.

It has become fully recognised that the custom could not be allowed to continue in the great timber reserves of the country nor in those reserves which were required to be kept in trust to supply the daily wants in fuel, grazing and minor produce generally, of the adjacent communities. In these latter all other considerations must necessarily be subordinated to the endeavour to keep the forests in such a condition as shall insure their being able to give a permanent supply of the materials required in the daily life of the neighbouring inhabitants. Firing of all such areas has, in most parts of the country, been strictly prohibited under severe penal laws, enacted entirely in the interests of the community at large. These village reserves, as they may be styled, may or may not be under the Forest Department. In the latter case they may or may not be under fire protection. Excluding the fire protected areas it may be taken as an accepted fact that all other areas occupied by, or in the neighbourhood of, grazing communities are annually burnt. In this latter category may therefore be included—

(1) The not inconsiderable area of boundary lines, interior fire traces, &c., annually burnt by the Forest Department or Civil

authorities as a protective measure to safeguard the fire protected forests.

(2) The large areas of grass savannahs (called by various names in different parts of the country) annually burnt by the Department with the same object in view.

(3) The annual firing of the majority of non-fire-protected forests and waste lands.

(4) The annual firing (and it may be given a separate heading owing to its vast importance on the question under consideration) of forest and waste lands in the vast majority of the Native States in the country.

RESULT OF THIS FIRING ON THE GRASS.

Now, what is the result of this firing upon the grass? We see in the papers before us that it is held that the grass steadily deteriorates owing to the finer species being killed by the fire and to the manure in the ash being washed away with the first heavy rain! We have read this statement with surprise! Consider for a moment the miles of forest boundary lines burnt every year. Are they not the nightly resort of the herbivorous animals of the adjacent heavy forest and are not the animals seen feeding upon them in the pink of condition and plumpness? Again, the burnt savannahs become full of game as soon as the young grass springs up. In Eastern Bengal the sann (thatching) grass areas are annually burnt over after the grass has been cut with the object of keeping down the growth of the coarser noxious grasses. and thus of obtaining a thick crop of the finer and more valuable thatching grass. Turning to the evidence of the members of the "Nilgiri Game Association," all long residents on the plateau, we see that there is a concensus of opinion against the statement that the grass deteriorates by being burnt. The reasons given by Sir Frederick Price, one of the members, may be taken as the generally expressed opinion of the Game Association on this point—"As regards the theory that burning destroys all the better classes of grass, and leaves only the coarser kinds, it is to be observed—if this is actually the case—that that which is left agrees remarkably well with the Toda buffalo,

whilst that which he gets now evidently does not. I think too much has been made of the point that the manurial constitnents of the ashes of the burnt grass are washed away by rain and lost. The principal ingredient of these is potash—a very soluble salt. The rain which comes after the burning has taken place—I speak of this part of the hills including the Kundahs—consists of brief and not really heavy showers, and the surface of the ground after a fire is not smooth. The dry earth drinks the water very rapidly, and very little of the constituents are carried away from the actual spot on which they lie....If this is not so, how comes it that after the grass has been burnt for a series of years beyond the memory of man, burning it still produces at the present time an abundant crop of sweet and green grass? That it does so is beyond denial.

Sir Frederick also alluded to the fact that the annual burning destroys a vast number of insects, such as hairy caterpillars and—that curse of agriculturists—the cockchafer beetle. The latter is to be found egg-laying in the earth at the roots of the grass during the burning season, and thus enormous numbers of beetles, and consequently eggs, are annually killed off.

RESULT OF GRASS FIRING ON THE MAINTENANCE OF THE HEAD OF GAME.

The opinion of all who considered the question of the grass burning on the Nilgiri plateau agreed upon the important point as to its effect on the maintenance of the head of game in the area. The new young grass attracted sambhar and other herbivorous animals to the plateau, and excellent sport was to be obtained as long as the annual burning took place. This of course is the common experience elsewhere in India. The broad fire lines, such as the 100—200 foot lines of the United Provinces Reserves, the burnt over tappas and savannahs, the waste lands all over the country are all haunted by game as soon as the young grass begins to shoot up. The same rule applies to the large areas of grazing grounds in the neighbourhood of big reserves and to the annually burnt over village forests. That this is so is of course fully well known to all Forest Officers who are at the same time sportsmen, and in the interests of the maintenance of the head of game in a district, and

more especially in a heavily shot-over district, they would be the first to advocate the burning of all grass areas where the burning did not actually involve the fire getting into fire protected forests.

THE EFFECT OF THE PROHIBITION OF GRASS BURNING ON THE GAME IN THE NILGIRI PLATEAU AND ELSEWHERE.

The effect upon the head of game on the Nilgiri plateau after the prohibition of the grass firing was enforced became most marked. The Forest Officer alludes to the fact that all the herbivorous animals left the plateau and sought the slopes of the hills which were still burnt over, and where they could therefore find the new young grass coming up after the first rains. This observation is borne out by the members of the "Nilgiri Game Association," who were asked to report on the subject, and by numerous other sportsmen, who have recorded it as an observed fact. It was pointed out that as a result of the two years' non-firing of the grass only seven sambhar head had been set up by the local taxidermist instead of the 25—30 in years past, and further that the deer having left the plateau to go in search of the grass on the lower burnt-over slopes had been killed off in large numbers by the jungly tribes, who all possessed guns, and that consequently the years of good work of the Association had been destroyed.

That sambhar, bison, and other herbivora will not remain in areas where they have been accustomed to find in the neighbourhood burnt-over grass tracts, once fire protection has been introduced on a large scale, is well known to sportsmen, and we should think to most Forest Officers, all over India. The quotation which heads these lines is from the pen of a well-known sportsman and Forest Officer, and the hills he was writing of are in the Central Provinces, famed for its fine shooting grounds. Will they remain so in the future?

A RESULT TO BE EXPECTED FROM A DECREASE OF THE HERBIVORA.

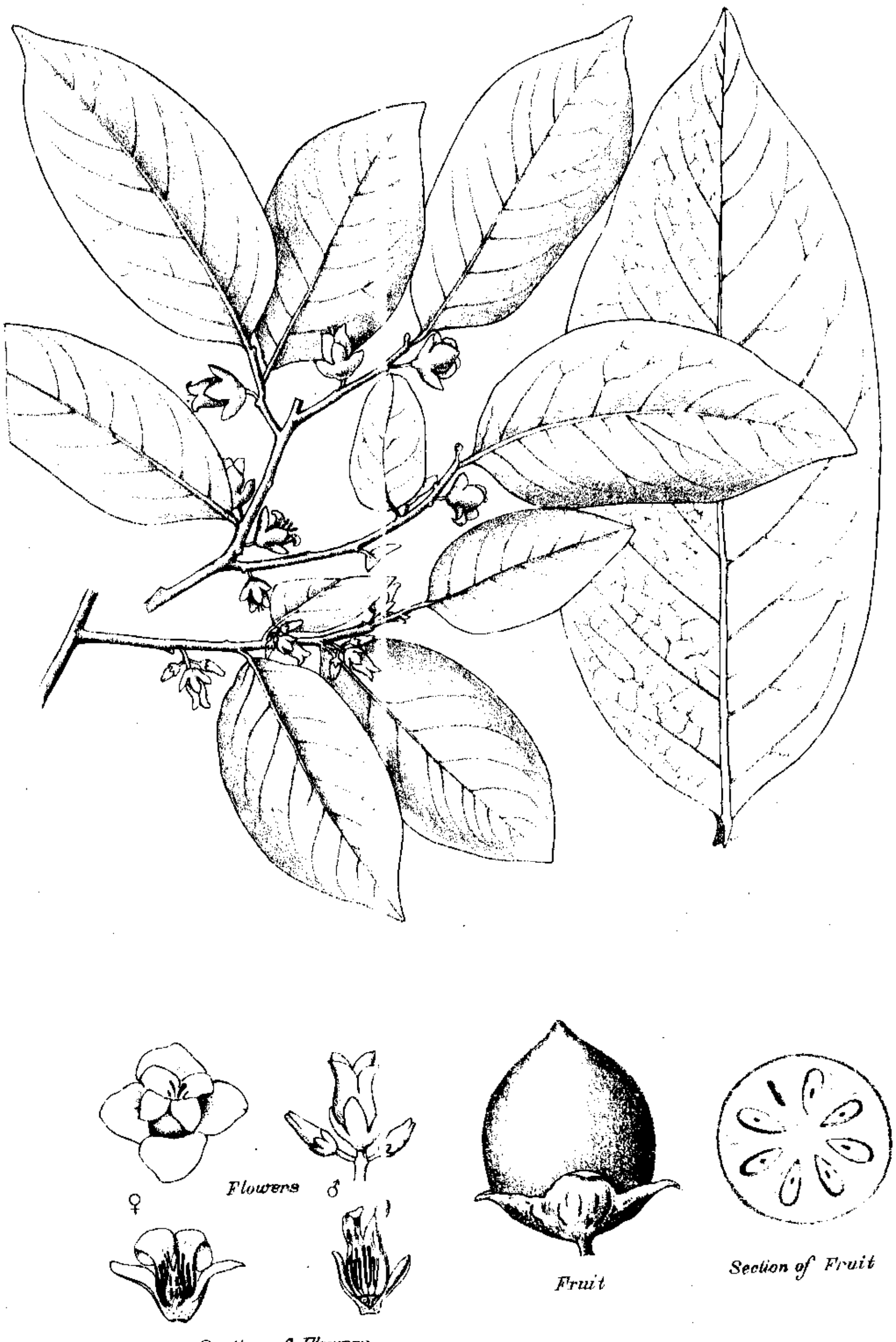
There is another reason, and a most important one, why it is almost essential that a certain head of herbivorous game should be kept up in the country. We allude to the presence of the larger

carnivora, who for the most part derive their sustenance from this source. The decrease in the head of herbivorous game in an area must almost of necessity be followed by a large increase in the mortality amongst the cattle of that district, and perhaps not alone amongst cattle but also amongst human life. A tiger will not usually take to cattle killing if he lives in an area where the procuring of a fat young buck is a matter of comparative ease. We write 'usually,' for the tiger's habits in this respect are very variable. It may be taken as certain however that tigers and the lesser carnivora will go to the village herds as soon as any difficulty is experienced in obtaining their more natural prey in the forest. It would, we believe, be by no means difficult to obtain statistics to show that a decrease in the herbivorous game of a district had been followed by a heavy increase in the mortality amongst the cattle of the village communities.

POWER OF THE FOREST OFFICER TO PROTECT THE HEAD OF GAME.

That the first duty of the Forest Officer must be to conserve, in the interests of the community, the protected reserves from fire, even when this means sacrificing the head of game, admits of no criticism and needs no insistence upon in these columns. But we think that it equally falls within the province of his duties to maintain as far as in him lies the head of game in the district in which he serves, and to ever keep before his eyes all available means of carrying out this laudable object. From the very nature of his work he is in the best position for obtaining reports and making himself acquainted with what this head of game roughly is and whether decreasing or increasing. We believe the day will dawn when the Forest Officer will be in a position to keep rough game registers in his office having this object in view, and such registers will be maintained not solely in the interests of the sportsman but equally for the advancement of the zoological knowledge of his district, and *ipso facto* of India as a whole, the habits of much of the game in which are but imperfectly understood.

PLATE XXIX.



Lith: by S. C. Mondul.

SCIENTIFIC PAPERS.

A NEW SPECIES OF DIOSPYROS.

DIOSPYROS KANJILALI, DUTHIE.

Diospyros Kanjilali, n. sp.—A small or medium-sized tree with a fairly long trunk. *Bark* greenish or ashy-grey and quite smooth like that of the *guava*, exfoliating in thin scales. *Branches* forming a rather narrow and open crown, not spinescent. *Leaves* $1\frac{1}{2}$—$5\frac{1}{2}$ inches long, elliptic to suborbicular, thicker than those of *D. cordifolia*, usually densely tomentose when young, becoming rigidly coriaceous and almost glabrous in age; midrib impressed above, prominent beneath, petioles $\frac{1}{3}$—$\frac{1}{2}$ inch. MALE flowers in short 3-flowered cymes, pedicels $\frac{1}{18}$ inch; bracts ovate, subacute, ciliate on the margins. *Calyx-lobes* broad and rounded, pubescent on both sides and with ciliate margins. *Corolla* $\frac{2}{10}$—$\frac{3}{10}$ inch long, slightly pubescent outside, glabrous within, pale-green. *Stamens* 16, in opposite pairs, united below; anthers awned, glabrous. FEMALE flowers axillary, solitary, nodding, pedicels about $\frac{1}{4}$ inch. *Calyx* (in fruit) accrescent; lobes spreading, broader than in *D. cordifolia. Corolla* dark-green, otherwise like that of male. *Staminodes* 8, alternately longer, the longer ones often toothed near the acuminate apex, the shorter ones obtuse. *Fruit* up to 1 inch in diameter, globose. *Seeds* about $\frac{1}{2}$ inch long, somewhat curved.*

Recorded by Kanjilal from Kalsi, Rajpur, Lachiwala and Thano in Dehra Dun, and from Ranipur, Dholkhand and Badshahibagh on the Siwalik range. It flowers during April and May. Other localities are —Chanda district of the Central Provinces,

* I am indebted to my friend Mr. Gamble for the following description of the wood of this species:—

Wood brownish-grey, with occasional iron-grey streaks, soft to moderately hard, no heartwood.

Pores small, very scanty, in radial groups 1—3, which are distant between the medullary rays and faintly in échelon. *Medull ry rays* numerous, very fine. Transverse lines very faint.

O 4952. Dehra Dun ... ... 50 lbs.

Duthie No. 9559, N. Kanara, Ritchie No. 972. Mr. Gamble has also collected it in the following localities:—Santal Parganas in Bengal No. 10614, also in the Madras districts of Ganjam No. 13657, Anantapur No. 20873, Bellary No. 16583.

This tree has already been alluded to by Kanjilal on p. 221 of his "Forest Flora," where he remarks—

"There is a tree occasionally met with in the Saharanpur and Dun Divisions * * * which differs from the montana* as described above in the following respects:—*Trunk* fairly long; *crown* rather narrow and open; *branchlets* not spinescent; *bark* greenish-grey, always smooth, exfoliating in thin scales; *leaves* larger 3—5 by $1\frac{1}{2}$—2 inch, oblong or elliptic, sub-coriaceous, brittle, pubescent or glabrescent, midrib impressed above, prominent beneath * * *."

It appears to occupy a position intermediate between *D. montana* and *D. cordifolia*, agreeing with the former in general habit, stature, smoothness of bark and in the absence of spines but differing by having thick coriaceous leaves, the male flowers in threes (not in panicles) and twice the number of staminodes. From *D. cordifolia* it may easily be distinguished by its smooth bark, absence of spines, the shape of the leaves, the glabrous and awned anthers, and by the number of staminodes; it also differs by having a more defined trunk with ascending, not spreading branches.

Plate xxx shows the leaves, flowers and fruit of this tree.

I have great pleasure in naming this tree after my friend and former pupil Rai Sahib Upendranath Kanjilal, to whom I am much indebted for a complete set of herbarium specimens and for some excellent photographs of the tree taken by himself.

KEW: J. F. DUTHIE.

24th March 1905.

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* This is *D. cordifolia* Roxburgh and not the true *D. montana* of Roxburgh, which is a comparatively rare tree in Northern India.—(J. F. D.)

ORIGINAL ARTICLES.

SOME FACTS ABOUT GUTTA PERCHA.

BY A. M. BURN MURDOCH, I. F. S.

CONSERVATOR OF FORESTS, FEDERATED MALAY STATES.

Gutta percha, derived almost entirely from trees growing *within six or seven degrees of the equator, is naturally one of the* most important products of the Federated Malay States, of Perak, Selangor, Pahang and Negri Sembilan. I will endeavour in this article to give a general idea of the subject, under the following heads :—

I.—General, species, distribution, etc.

II.—Measures taken for protection, past and present.

III.—Methods of extraction.

IV.—Manufacture, adulteration, lines of transit.

V.—Properties.

I.—GENERAL, ETC.

The word gutta percha is derived from the Malay word "Getah," which means any substance, such as gum, latex, resin, etc., which exudes from wounds or incisions in the bark of trees. "Percha" refers to the Malay name for Sumatra, "Pulau percha." Gutta percha therefore originally meant Getah from Sumatra.

Gutta percha in its pure state may be taken to mean the coagulated latex of trees belonging to the genera Palaquium, Syn (Dichopsis, Isonandra) and Payena. Inferior gutta perchas are yielded also by several species of Bassia, and one or two species of Ficus, but these will not be discussed here, the object of this article being to consider the best gutta percha producing species, namely, those above mentioned, which are also the ones found in the *Federated Malay States.*

Mr. Curtis, in the "Agricultural Bulletin of the Federated Malay States and Straits Settlements," has made the following observations :—" Palaquium, the tree referred to as 'Getah taban,' was

originally described as an *Isonandra*, but subsequently found not to agree in certain particulars with that genus, consequently a new genus was created, called Dichopsis. Later it was found that the characters of Dichopsis were identical with those of Palaquium, which, being of older date, takes precedence under botanical etiquette." The best gutta percha is yielded by a tree known as "Getah taban" in these States, of which there are several varieties—*e. g.*, Taban merah—Palaquium oblongifolium or gutta.

Taban chaier—Palaquium sp.?

Taban puteh—P. pustulatum.

Taban baik—P. sp.?

Getah sundik—Payena Laerii.

All these are good except Taban puteh, which is much inferior to the others. Considerable doubt exists amongst botanists as regards the specific names of numbers 2, 3, and 4, and P. oblongifolium and P gutta are by some considered as distinct species. Local names cannot be depended on at all, as they differ in the different States. Payena is not found in anything like such quantities as Palaquium, and it is chiefly with the latter that I propose to deal.

Palaquium gutta is found in all four States, the best areas lying between 2 degrees and 5 degrees north. It must be considered as a dominant species, but exists at present, owing to the unregulated and wholesale fellings by natives some years ago, only in the seedling and small pole stage.

It occurs most frequently on the low hills and plains, often on steep hill sides, and up to 2,000 feet above sea level, and even 3,000. It is found well represented in large blocks of forest, varying in size from a few hundred acres to 10,000 or 15,000 acres in extent, while it may be practically absent in other areas for long distances. On close examination a great many of the young plants are found to be stool shoots, but there are many seedlings also, although seed trees are not now to be found. This looks as if the felling of mature trees did not cease till comparatively recently. The "Taban" tree is a shade bearer of the most pronounced description, and is able to maintain the struggle for existence successfully, if

Plate XXX.

H. C. Robinson, Photo.

Palaquium gutta high forest showing the stems of a group of seedlings and small poles beneath.

slowly, in these dense evergreen forests. It grows to a considerable size; the largest I have actual knowledge of in this country was in Penang, and measured when blown down 52 feet in height and 42 inches in circumference at 14 feet from the ground. I have seen mention of a tree 140 feet high in the Philippines, and there is no doubt that it is an exceedingly slow grower. At present poles 30 to 40 feet high are fairly common in these States, but large trees are rarities. In the Straits Settlements Palaquium only exists in the natural state to a very small extent, *e.g.*, in Malacca near Nyalas, not to mention a few scattered trees in Penang and elsewhere. We must rely in the Colony on our plantations or on the Federated Malay States, where large areas are found containing this plant in the wild state. At present a small plantation exists at Batu ferringi in Penang and another in Malacca and Singapore. The P. gutta tree is very easily recognised by its leaves, which are coriaceous, oblong or obovate-oblong and obtusely acuminate; in colour they are of a beautiful coppery gold colour on the under surface, and dark glossy green on the upper. In a mature tree the leaves are about two inches long, but much longer in the young plant. In the forests this tree appears to be very free from the attacks of disease, the only one I have seen being in plantations, and caused by the larva of a moth which I believe to be a species of Rhodoneura.* This larva eats the young shoots and leaves, and has done appreciable damage in Malacca.

4.—MEASURES OF PROTECTION.

The qualities of gutta percha became known about 1845, and the demand steadily increased from that time, till in the seventies there was a rush for it by the natives of these States, the price rising rapidly till 1902. Between 1895 and 1900 the exports from Singapore rose from 2,642 tons to 5,831 tons. It may safely be said that from 1890 onwards the natives of these States were doing their best to obtain gutta percha. Their method of extraction consisted in felling every tree they came across and extracting the

* *Rhodoneura myrsusalis*, Wlk.

latex in a wasteful, rough and ready manner, so that by the time the authorities awoke to the fact that Palaquium was being exterminated (about 1898), it was too late to save trees large enough to produce gutta percha. It is difficult to see how this could have been prevented, however, as at the time there was no properly organised Forest Department, and whatever measures might have been adopted it would have been impossible to effectively carry out in these dense, unpopulated, evergreen forests.

In Perak the export of gutta percha was prohibited in 1881, but allowed again in 1887, the issue of passes to collect being prohibited in 1900. The first timber rules, published in 1898 by the British Residents of the various States, contained the initial protective measures, which were to the effect that no rubber-bearing tree should be felled if of less than 8 inches diameter. This rule could not, I imagine, be enforced in practice, owing to the want of an organised staff. In 1899 and 1900 the matter was taken up by the High Commissioner and the Resident General, and in the latter year the British Resident, Pahang, issued orders to all his officers to do all that lay in their power to prevent the destruction of gutta percha producing trees.

The question of planting was also discussed, but not in a very practical manner.

The Forest Department was started in each State by the appointment of a local man, in Perak in 1895, in Selangor in 1898, in Negri Sembilan in 1899, and in Pahang not till 1902, when a member of the Indian Provincial Forest Service was sent over on deputation at my request, I having been deputed from India in October 1901 as Conservator of Forests.

Early in 1902 I suggested that an export duty of 80 per cent *ad valorem* be imposed on all gutta percha leaving these States, as a means of putting a stop to the extraction and collection of this product, a considerable period of absolute rest being obviously indicated for all gutta percha producing trees.

The rules were also amended and the felling of trees for the extraction of the latex was prohibited. In addition to these precautions departmental instructions were issued to the effect that

H. C. Robinson, Photo.

High Forest of *Palaquium gutta* with seedlings and poles beneath, all naturally grown.
(Federated Malay States).

no licenses for the extraction of gutta percha were to be issued. At the present time therefore it must be difficult to collect gutta percha and export it in sufficient quantities to make it pay. That a certain amount of smuggling goes on I have no doubt, from the fact that two or three cases have come to light in which Chinamen were found in possession of small quantities and were convicted of the offence. Since 1902 the staff of the Forest Department has been greatly increased, and I have reason to believe that the Government have done and are now doing all that is in their power to assist in the preservation of this valuable product.

As regards measures for protection from other causes of destruction, such as alienation of land for mining and agriculture, the only plan is to reserve all the valuable Palaquium areas, constituting them forest reserves wherever possible, without interfering with valuable tin-bearing land. We already have an area of about 60,000 acres reserved, fairly rich in young "Palaquium," chiefly in Perak and Selangor, and probably as much more remains to be taken up in Pahang and elsewhere.

Again, before any large area of land is alienated the department is referred to, and if alienation takes place in spite of the presence of Palaquium, we are given the opportunity of taking away the young plants and transplanting them into reserved areas. In the course of time, when all forest reservation has reached its natural limit, Palaquium is bound to disappear from all tracts outside, nor does this matter, as it is only practically possible to watch defined areas when placed completely under the control of the Forest Department.

The systematic exploitation of the gutta percha areas will only be possible in reserved forests, tracts being taken in hand annually.

(c) Regeneration.

The natural regeneration of "Palaquium," as already stated, is very good, but growth is slow and assistance must be given. Our object now is to encourage only the best species, P. oblongifolium and gutta. Regular plantations, *i. e.*, planting in cleared

areas from seed, is at present impossible in these States, as no seed is available. The method followed by the Forest Department here is to cut lines through the dense undergrowth in the forest reserves, taking up regular areas in turn, and to transplant into these lines young Palaquium seedlings taken from outside the reserve in forests that cannot for various causes be protected, or taken from groups inside the reserve where they are growing too close together. At the present time we have an area of more than 1,000 acres so planted in Selangor.

In the Trollah reserve in Perak Palaquium seedlings are so numerous in the seedling and pole stage that planting over a considerable area is unnecessary. Here we resort only to improvement fellings, transplanting young plants into blanks only wherever necessary. The improvement fellings consist in clearing away undergrowth interfering with young Palaquium plants, the operation being repeated yearly or once in several years, as may be necessary. By this means the rate of growth of the young trees is greatly increased. I have found the effect of this process to be very beneficial even in the two years since it was started. By such simple methods as these it is hoped in a few years to have a very considerable area of young Palaquium trees about 40 to the acre. One advantage in this system is the freedom from the attacks of insects to which trees grown in pure plantations are liable. A similar area to that in Selangor exists in Malacca, but the plants are put in closer together and were obtained from Sumatra. Similar plantations exist at Bukit timah in Singapore, and at Batu ferringi in Penang, but on a small scale.

III.—METHODS OF EXTRACTION.

The latex of Palaquium exudes immediately on tapping, *i.e.*, cutting the bark, and consists of a milky-looking white fluid, which, in young trees, is rather thin. It coagulates very quickly and turns in the case of "Taban merah," P. gutta, a light pink colour when hard. This is doubtless due chiefly to the fact that the under side of the bark of this species is reddish, and small pieces of the bark get mixed up with the latex while it is being rolled off. The

H. C. Robinson, Photo.

Natural Palaquium high Forest in Federated Malay States with undergrowth still uncleared.

rapid coagulation and the fact that the tree only bleeds for a very short time from the cut are at the root of the disastrous system of extraction of the latex, *viz.*, by felling the tree, tapping the living tree as with Para rubber, being, it was supposed, impracticable.

The native method is to fell the trees and to cut ring-like incisions round the fallen trunk at intervals of about 9 to 12 inches or even less. These are quickly filled by the latex, and in about half an hour the pure gutta percha can be rolled off on sticks. The product is then boiled and shaped as desired, but many impurities are included, such as chips of wood, bark, dirt, etc.

This process is of course very wasteful, as a good deal of latex falls to the ground; the latex which is contained immediately underneath the cut and touching the ground is also inaccessible. Again, the gutta percha contained in the leaves and remaining bark and in the twigs is not collected, and, as will be seen later on, this is a very considerable amount.

The same method is applied to Getah sundik, Payena laerii, which produces a very white gutta percha.

Dr. Sherman, in the Philippines, estimated that only 1/35 of the total quantity contained was extracted by natives, and from other experiments it is said to be certain that not more than 1/10 is obtained.

In Penang in 1900 a tree was felled 39 inches in circumference at 5 feet from the ground, with a height of 55 feet, height to the first branch being 35 feet. This tree was thought to be about 50 years old. The gutta percha was extracted by the above mentioned native method under the personal supervision of the Superintendent of the Botanic Gardens, and yielded only 1½ lbs. of gutta percha. Another tree blown down in 1901, 52 feet high and 42 inches in circumference, yielded by the same method 1⅓ lbs. only. Dr. Sherman had a tree felled in the Philippines 160 feet in height and 8 feet in circumference which yielded only 8½ lbs., whereas he estimated that could all the latex in the leaves and bark have been obtained he would have extracted 150 to 200 lbs.

Other methods of extraction have been tried, *e.g.*, from the leaves and bark. The green leaves of the best species of *Palaquium* contain up to 3 per cent of pure gutta percha and the bark about 5 per cent. A company was started in Singapore which, by simple mechanical means, extracted gutta percha from them, but I believe that great difficulty was met with in the procuring of sufficient leaves. I believe this method of extraction could be employed by the Native States were the necessary plant set up close to the forest. Extraction can also be effected from dried leaves by this method, but there is great loss through oxidisation while drying gradually.

There are also various methods of extraction of the latex by chemical means, but I believe I am right in saying that these are less satisfactory as regards the produced gutta percha. I am very doubtful whether extraction from the leaves only, *i. e.*, from leaves gathered from standing trees without tapping the tree, would be a success from an economical point of view. From what we know, the best method would seem to be to fell the tree, but to extract every ounce of latex from the bark, twigs, and leaves of the felled tree. This would not present any great difficulties. In any case it is obvious that the method of collection from leaves only is a most dangerous one if carried out by natives as they cut down the young saplings in order to reach the leaves, otherwise inaccessible without great trouble, whereas were they collecting by their own methods it would not pay to fell trees of less than a certain size. Again, Palaquium appears to be a very slow growing tree and what effect the stripping of some or all of the leaves, even at considerable intervals, would have is very uncertain. So far the Forest Department in the Federated Malay States has not concerned itself greatly with methods of extraction; all its energies must for the present be devoted to the protection and cultivation of the trees. There is ample time in which to make experiments. Lately some fairly large trees have been found in the forests, and I intend, before long, to make experiments in tapping the living trees; it is quite possible that, by tapping the tree from the base upwards to a considerable height, a good quantity

of latex may be obtained without seriously affecting the vigour of the tree. Of this, however, I have no great hopes, as I have heard that tapping as hitherto attempted has had an injurious effect.

I may here mention that from the leaves of P. pustulata which I sent to Singapore but very little gutta percha could be extracted; in fact, practically none at all. From P. gutta, however, over two per cent was obtained, but I am informed that the gutta percha so obtained is not of the first quality and will not do for cables.

IV.—MANUFACTURE AND TRANSIT.

According to M. Collet, who published a pamphlet on the subject, nearly all the gutta percha of commerce goes to Singapore, where it passes through the hands of Chinese middlemen, the cleverest adulterators in the world. To such an extent has adulteration been carried on that the finished article they turn out resembles but slightly pure gutta percha as taken from the tree, and he adds "it is impossible to determine the origin of the gutta percha as comprising the *reboiled* of Singapore." This is greatly to be regretted, and I feel sure that the present enormous fall in price is partly accounted for by the adulteration to which this product has been subjected. As will be seen further on, the prices lately quoted in Singapore for gutta percha are less than those current for very ordinary India rubber of low grade. It is a well known fact that the exports of gutta percha from Singapore greatly exceed the imports. This is, however, partly explained by the fact that very inferior "Getahs" such as "Jelutong" (Dyera costulata) are shown when imported as inferior India rubbers, and then mixed with gutta percha and exported as such. "Jelutong" can hardly be called a gutta percha however, and this only bears out my statement. Whereas the price of gutta percha rose in 1902 to $600 per pikul (1 pikul = 133⅓ lbs.) the average price of Getah Jelutong is only $6 50 cents. Gutta percha also finds its way into Singapore under the name of India rubber; also a certain amount is brought in by passengers and smuggled through in small quantities at a time

V.—PROPERTIES OF GUTTA PERCHA.

As is generally known, pure gutta percha when heated becomes soft, malleable and plastic, but when allowed to cool it becomes hard, retaining any shape given it when hot. Pure gutta percha is so hard that it would be difficult to drive a nail into it when in the cool state. In composition it differs from India rubber physically more than chemically. It burns freely with a very characteristic odour. When exposed to air for any length of time it oxidises, when its insulating qualities and durability decrease, but if kept in water its duration is indefinite.

Acids do not affect it unless concentrated.

Its chief value of course arises from the fact that it is unaffected by sea water; this and its insulating qualities make it invaluable for submarine cables.

The chemical composition according to W. P. Brant is as follows:—

Carbon	86·36
Hydrogen	12·15
Oxygen	1·49
	100·00

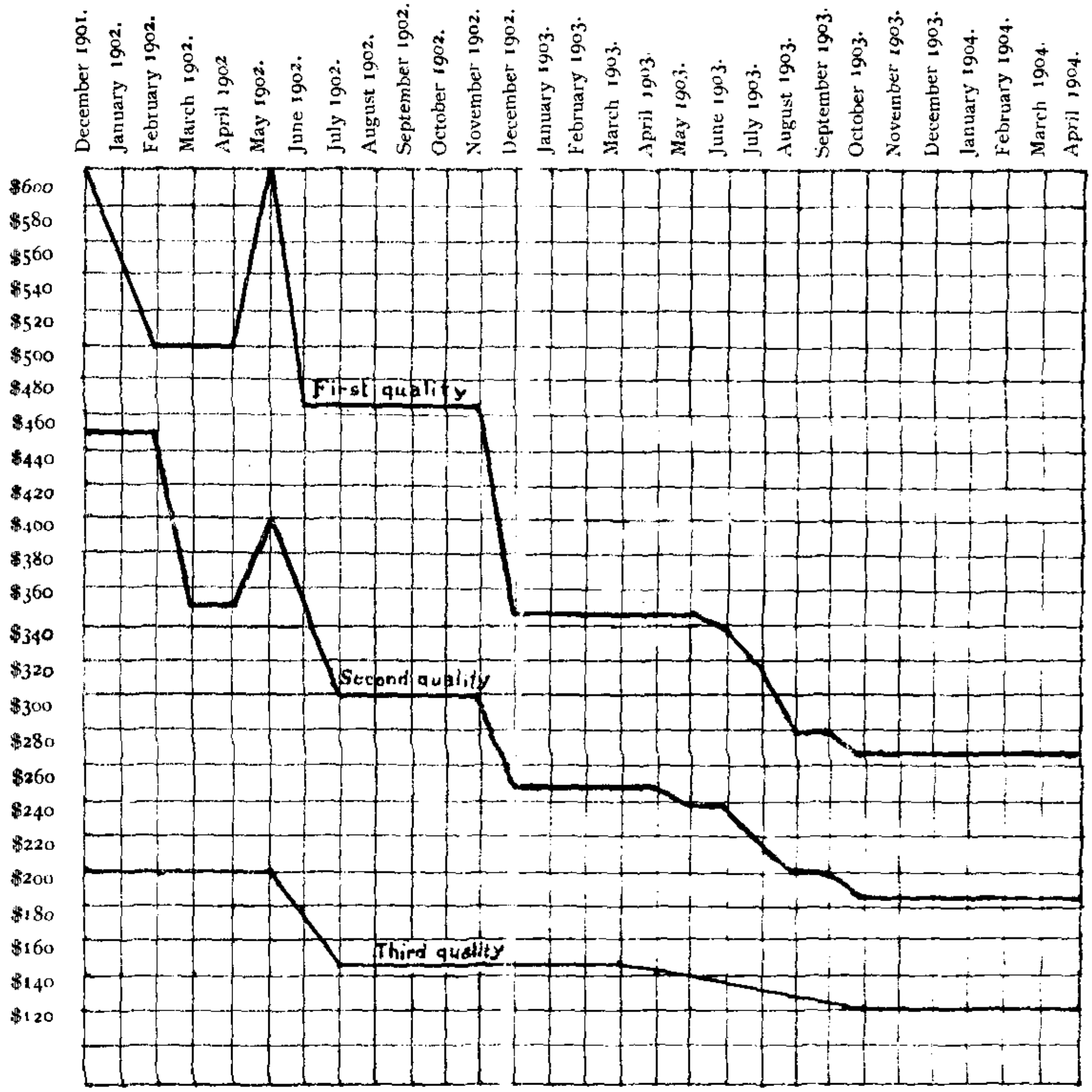
Its physical composition according to Payena—

Gutta	78·82	
Albane	16·14	(crystalline resin)
Thiarite	5·04	
	100·00	

It is a great pity that in Singapore and in the Malay States generally the term "gutta" is used indiscriminately to mean either India rubber or gutta percha, as this leads to great inaccuracy in returns.

SOME FACTS ABOUT THE TRADE.

In 1880 Great Britain imported from the Straits Settlements 68,862 cwt. of gutta percha valued at £505,821, while in 1876



NOTE.—The difference in price between the three qualities is much smaller in April 1904 than in December 1901, when prices were *high*. This appears to me an indication of deterioration of 1st and 2nd quality.

the imports were only 19,665 cwt., and in 1878 49,387 cwt. Thus it would seem that the rush for this product came on between 1876 and 1880, or within the last 28 years. In 1890 the price was 316 per pound, but rose to $4·60 cents in 1902.

The exports from Singapore for the last 18 years are as follows :—

1886	Pikuls	33,946.	1895	Pikuls	43,910.
1887	,,	25,539.	1896	,,	43,769.
1888	,,	23,717.	1897	,,	45,417.
1889	,,	59,493.	1898	,,	93,398.
1890	,,	78,930.	1899	,,	78,343.
1891	,,	54,926.	1900	,,	97,399.
1892	,,	41,990.	1901	,,	73,815.
1893	,,	38,945.	1902	,,	63,559.
1894	,,	42,341.	1903	,,	35,661.

The question which naturally forces itself on one's mind is, will there be any demand for gutta percha by the time the Federated Malay States forests have been given time to recuperate? A substitute may be invented or submarine cables may become unnecessary ; either of these two contingencies failing, it is difficult to see why the demand should not be even greater than heretofore. In this case it will be advisable for the Government to transmit its gutta percha direct to agents or manufacturers at home, and above all not to send it to Singapore to be changed beyond all recognition by the Chinese middlemen. Appended is a statement of the highest prices of three qualities of gutta percha exported from Singapore during its zenith and decline. I am told that this decline of first quality is largely due to the falling off of the demand for the best quality owing to the cessation at present of work on laying cables, but do not think this the only cause.

For the photographs here reproduced I am indebted to Mr. H. C. Robinson of the Selangor Museum. They represent a forest in which the dense undergrowth has been cleared, showing up the young Palaquium plants those with the rather stiff looking leaves. In Plate xxviii the tall sapling in the centre is a Palaquium gutta, also the one close to it.

Plate xxx shows a group of seedlings and small poles under the big forest.

Plate xxxi the same; these are all naturally grown. It is difficult to obtain good photographs owing to the bad light.

Plate xxxii shows some forest not yet cleared of undergrowth; the tree with the white light on the stem is a Palaquium.

THE GRAZING QUESTION IN MADRAS.

BY F. A. L.

The future of the forests depends so much on the amount of grazing that they can be saved from, while the present of the ryot depends (or is said to depend) so much on the number of cattle which he can maintain at a nominal cost, that it appears impossible to reconcile these two divergent interests. The interests of the cultivator are rightly considered of paramount importance, and it is impossible to convince the ordinary ryot that grazing restrictions, necessary from a forest point of view, are advantageous to him. For generations he has been accustomed to keeping as many *cattle as he could find food or water for, not for tilling his land,* but as the cheapest and most convenient method of bringing produce from the forests and depositing it in the form of manure on his land. In what may be called, so far as forestry is concerned

the prehistoric days prior to the introduction of the Forest Act, certain areas were selected as reserves; these areas were theoretically closed to man and beast, and it was probably for this reason that an order was issued to the effect that no reserve should include any public path. Consequently the reserves were very limited in area, and as free grazing was allowed everywhere except in the reserves, their formation did not materially diminish the area available for cattle of all descriptions. But with the reorganisation of 1882 and the introduction of the Forest Act, reserves were soon formed on a large scale, and the old idea of the word "reserve" being synonymous with "area rigidly closed to man and beast" had to be modified. In 1885 Mr. Gamble advocated light grazing in the Nilgiri reserves, and in the same year Colonel Campbell Walker declared himself in favour of light grazing in the forests of the plains, defining "light" as one head of cattle per five acres of forest after excluding all bare and rocky patches. Various proposals for limiting the number of cattle to be admitted to a reserve were made, but they all failed, those on the "first come first served" principle because local cattle-owners might be excluded from a reserve by the prior advent of an exotic cattle breeder with a large herd, and those on the villageman distribution principle because of the impossibility of effecting an equable distribution by the forest staff then available or by village officers. It was then decided that no restriction on the number of cattle to be admitted to the reserves could be attempted, and grazing permits for which nominal fees were charged were issued to all-comers. At first these permits held good for all the reserves of the district in which they were issued, and in the hot weather as soon as the pasture in one reserve was exhausted, by overgrazing or by fire, the cattle were moved on to the next reserve irrespective of the number of cattle it might already contain. The results, in a bad dry season, may easily be imagined; half starved cattle from a reserve which had been cleaned out of fodder or water crowded into the nearest reserve and accelerated the disappearance of the available fodder therein, after which, augmented by the cattle which habitually grazed there, they moved on to overcrowd a third reserve, and so

on, till they reached a tract of forestless country which they were too feeble to cross, and there they died by the hundred.

In order to prevent this reoccurring and to ensure a certain distribution of cattle, the area for which permits held good was reduced; the unit of area became part of a reserve, a reserve, or a group of reserves according to circumstances, but still no restrictions on the number of cattle to be admitted to each unit were imposed. If a cattle-owner wished to transfer his cattle from one grazing block to another, he had to pay for new permits for the second block, and though the grazing fee was and is quite nominal (three annas per cow per annum) this double payment gave rise to numerous petitions. It has no doubt augmented the grazing revenue in many districts, but the cattle-owner considers it an injustice and has good arguments on his side. Owing to the absence of all restrictions on the number of cattle admitted to each block, certain favourite blocks soon get overcrowded with local cattle to which in the dry season are added herds of breeder's cattle; fodder or water or both fail, and the cattle-owners who have paid for grazing for a year demand that they may be allowed to move their cattle without further payment to a block which contains fodder. I use the word *fodder* instead of *pasture* advisedly, for in many of the reserves in the plains, after the disappearance of all pasture, cattle are fed on the leaves of trees, cowherds lopping off branches freely, and at the end of the hot weather these overgrazed reserves present a pitiable spectacle: ground as hard as iron and as bare as a rock, not a leaf or a green shoot within six feet of the ground, trees barked and lopped in all directions; no wonder that natural reproduction hardly exists in the reserves, and as for the unreserved lands they are past praying for. From the moment that payment was demanded for grazing in reserves, the pressure on unreserved lands increased; no man would care to pay three annas on the chance of getting grass in a reserve so long as he could keep his cattle alive on the unreserved lands, but as the area of reserves increased the free grazing area diminished and also the free felling area, with the result that the denudation of unreserved lands was enormously accelerated, and most of them are now

useless for pasture except during the monsoon months. Goats of course were the principal factors in the work of denudation and destruction, and in some districts their depredations are still allowed even in reserved forests because the ryots say that goats are necessary to agriculture; in other districts, however, the imposition of a grazing fee of from eight to twelve annas a goat has resulted in the disappearance of a large proportion of the herds of goats formerly maintained, and it has not been shown that agriculture is any the worse off in consequence. If it is true that "nature abhors a vacuum" *it is equally true that "forests abhor goats,"* and as a well-known French Forest Officer said with reference to the goat question in Algeria, "If anybody will show us how to grow goats and forest on the same area we shall be much obliged, for no Forest Officer has yet succeeded." Goats must sooner or later be relegated to unreserved lands, the denudation of which will limit the number that can be maintained; they should not enter into the question of provision of grazing in reserved forests.

What then will be the future development of the grazing question? If unlimited grazing continues, deterioration and eventual disappearance of the forests must be the result. There is no doubt that unlimited grazing is not the best treatment for the forests; is it the best for the cattle-owner? Under it the local cattle-owner finds the reserves in his vicinity overrun with cattle belonging to breeders; he pays a grazing fee with no certainty of obtaining grass for his cattle; at best his cattle get half rations and deteriorate, and in times of scarcity he loses many that might have been saved if the number of cattle admitted to the reserve had been limited to its grazing capacity. Given a sufficiency of grass his cattle would improve, and so would the forest growth on which he counts for his building and agricultural materials. In fact it is generally admitted that unlimited grazing is an evil, but the *difficulty of restricting* the number of cattle without hardship to the poorer cattle-owners has hitherto prevented any attempt at limitation. The difficulty is not insurmountable, but requires careful treatment. Firstly, what are the classes of cattle for which

grazing has to be provided? They may be divided into—(1) plough and domestic cattle, (2) cattle kept for the value of their manure, (3) cattle kept for breeding purposes. The country would not suffer materially if class 2 were eliminated; other manures and other means of bringing manures to the fields would soon take the place of these manure collectors, and the quantity of straw and pasture available for use by the remaining two classes or for sale would be so largely increased that fodder famines would become rare. Class 1 has to be provided for locally, and class 3 in the large forests in which local demand falls far short of the supply of pasture. In 1890 the Madras Government outlined a scheme for light grazing and stated that cattle required for agricultural and domestic purposes must have first claim on reserves; that if this were not done the result of protection would simply be a large increase in the number of animals requiring pasture and the consequent failure of all efforts to permanently improve the grazing grounds; it further considered that grazing should be provided for the cattle of every landholder at the rate of two bullocks and one milch cow for every five acres of land occupied. Unfortunately this does not seem to have been brought into force, either from want of establishment, or from want of reserves. It is quite conceivable that an isolated reserve of, say, 1,000 acres extent may be surrounded by villages containing 10,000 acres of occupied lands, and the grazing demand based on the above scheme would amount to 6,000 head of cattle. No scheme for the distribution of grazing can succeed unless it is based on the amount of grazing available. It has been suggested that the grazing fees should be raised until the demand is reduced to the grazing capability of the reserves, but this would entail the exclusion of the poorer classes of ryots in favour of the wealthy landowners and the cattle-breeders. It would, on the other hand, diminish the number of cattle kept for manuring purposes, and this is one of the principal objects to be attained in localities in which the demand for pasture exceeds the supply. In such localities the ryot must learn to substitute other forms of manure, and an increase in the grazing fee would make him seek a different method of enriching his land. It is only the

existence of cattle kept for manuring purposes that necessitates the grazing fee being kept at its present nominal sum; in some districts higher fees are charged for breeders' cattle, and in most districts plough cattle are stall fed. A gradual increase in the grazing fee might therefore be allowed. But the complaining ryot always excites sympathy by the plea that he cannot afford to pay grazing fees for his agricultural (*i. e.*, plough) cattle, and has been known to make this an excuse for his inability to pay his land assesment; this of course is no argument against the levy of moderate grazing fees, for if the land assessment is so high that the ryot cannot afford to spend three annas per annum on the maintenance of each bullock required for cultivation purposes, it is evident that the land tax is excessive; the same argument would apply if instead of three annas the grazing fee was three rupees, which for a yoke of bullocks comes to 3·15 pies per day, a sum considerably below the actual cost of stall feeding. It would, however, be impossible to suddenly raise the grazing fees by any considerable amount and, though a gradual increase in fees will lead to a gradual decrease in the number of cattle, some other means must be adopted to put a stop to the excessive grazing in reserves while at the same time safeguarding the interests of the small and poor landholders. This can best be done by bringing into force, with certain modifications, the Government scheme of 1890.

No grazing block should contain more than one compact block of forest; it is immaterial whether the block is a reserve, a group of reserves, or a portion of a reserve; the division of forests into grazing blocks must depend on local circumstances. From every village adjoining a block the Kurnam or village accountant should submit a statement showing the number of landowners holding (1) less than five acres of land, (2) from 5 to 10 acres, (3) from 10 to 15, and so on; from these statements the grazing demand should be calculated at the rate of two plough cattle and a cow for every five acres, or other unit (the area worked by a yoke of cattle varies enormously in different districts or even in parts of one district); the grazing "possibility" of the block should also be calculated, and if the possibility exceeds the demand grazing

permits can be issued to the landowners in proportion to the extent of their holdings; if, on the contrary, the demand exceeds the possibility, the issue of permits must be limited to the latter, and must be proportionate to the individual demand.

In the first case (possibility exceeds demand) the question arises, what is to be done with the excess grazing available? If, within reasonable distance, there is a grazing block in which the position is reversed, the excess can be allotted to the villages concerned; in other cases it may be allotted either to manuring cattle or to breeders' cattle, according to circumstances; if to local manuring cattle the grazing permits might be sold by auction, if to breeders' cattle they might be sold at fixed rates, higher than those charged for plough cattle which are kept low in the interests of agriculture. In the second case (demand exceeds possibility) what is to happen to the cattle for which permits are not issued? Unless other grazing blocks are available in the vicinity it will be a case of the survival of the fittest. The Forest Department cannot give more than it has got; if there is pasture for 1,000 head, and the demand is for 2,000 head, either the forest or the cattle must go; now, every acre of forest that goes means decreased pasture, and the result of sacrificing forest to cattle would be that in a few years' time the possibility would be 500 head instead of 1,000. It is evident therefore that in order to maintain the amount of pasture available the excess number of cattle now existing must disappear or be supported in some other manner.

The above scheme provides cheap grazing up to the amount that the forests can support for agricultural cattle and ensures a fair distribution of permits among landholders, and this is as much as Government can be expected to undertake, but what will be the result when the demand for pasture exceeds the supply? By the universal law there must be an increase in the price of the commodity in demand, and as actually most of the plough cattle are stall fed, the permits issued at a low rate for a certain purpose will be sold at a premium to the owners of herds of manuring cattle; the small land-owner with his one pair of bullocks will get no grazing for them in the reserves (he does not require it!) but will

make a few annas by selling his permits to his rich neighbour, and this will pave the way for a general increase in the grazing fees in a few years' time. If then the eventual result of this scheme, which involves a great deal of work, is the increase of grazing fees, would it not be simpler to go straight to the end and gradually raise the fees? I think not, because the above scheme limits grazing to the possibility of each forest *at once*, whereas the gradual increase of fees would take years to effect the same object, and in the meantime the possibility would be steadily diminishing.

EXTRACTS FROM OFFICIAL PAPERS.

THE FIBRE OF HIBISCUS TILIACEUS AND OTHER PLANTS AS SUBSTITUTES FOR JUTE.

An article on "Jute in Burma" having appeared in the *Rangoon Times* of the 25th August 1904, my attention was invited thereto by the Local Government, and a report was called for. With the approval of Government I send you the following account:—

OCCURRENCE OF HIBISCUS TILIACEUS IN BURMA AND REPORT ON THE SUBJECT GENERALLY.

Hibiscus tiliaceus (Burmese *Thinban Shaw*) belongs to the natural order Malvaceæ and is allied to the cotton plant, to which its flowers bear a close resemblance, both having large bright yellow petals with a claret-coloured centre. It is plentiful in Lower Burma, generally along the tidal rivers and creeks, and this would seem to show that it thrives best on a saline or moist soil.

FIBRE.

The Thinban Shaw yields a fibre of average quality, which is probably more durable than jute if subjected to wetting, and would consequently do better for sacks which may have to stand on damp ground. It is a matter for planters or Government to decide whether its cultivation at the present day would pay better than that of other crops. In the case of China grass (Rhea) the manufacturers expect the cultivators to produce the raw material in large quantities before they will guarantee a high price for it; yet the pre-eminent qualities of this fibre are well known. With a less famous fibre, as the one we are now considering, desultory experiments are not likely to attract capital. An experiment of this nature has been tried by Mr. Le Fevre, but was discontinued evidently for want of sufficient capital. It takes time for the special qualities and the most suitable mode of treatment of a new fibre to be learned by manufacturers who may have to order special machinery for dealing with it; consequently

producers must be prepared to wait for profits until the produce they offer has not only established itself in the estimation of buyers, but taken a firm hold of the market.

LOCAL MANUFACTURE OF GUNNY BAGS.

It is quite probable that the Thinban Shaw or other suitable fibre would pay if the plant were cultivated and the fibre locally manufactured into gunny bags which are so largely required in Burma by the paddy and rice trade. It has been suggested by the Editor, *Rangoon Times*, that this might be done by hand looms in the villages, but owing to the want of enterprise and industry on the part of the inhabitants this is doubtful. Government might, however, grow the fibre or buy it from the cultivators and make it up into gunny bags at the jails.

VALUE OF THINBAN SHAW.

If this fibre were sent to market in the condition that jute is usually sent, it would probably fetch about £12 per ton or perhaps a little more. From the account given by Mr. Le Fevre he was offered £20 to £35 per ton. His specimens may possibly have been prepared with more than ordinary care, and thus have obtained higher quotations for a more highly finished article than the ordinary Calcutta jute. In fact, I am informed that he has a secret method of treating the fibre. He states that he worked it up into rope, matting, and gunny, and also dyed the fibre in different colours. Unfortunately he could not supply me with samples. The prices obtained by Mr. Le Fevre are very high, even at the lower quotation of £20, as the length of the staple was only 4 to 5½ feet, whereas Bimlipatam jute is said to average 7 feet and Naraingunge jute (the real article) 8 feet in length. It would no doubt be possible in cultivation to obtain Hibiscus fibre up to 8 feet in length.

NATURE OF THE CONCESSION GRANTED TO MR. LE FEVRE.

Mr. Le Fevre, who now resides in Rangoon, was granted a free permit to collect the fibre from July to December 1900, in the unclassed forests of the Toungoo district. In October 1900 he

applied for and was allowed an extension for one year. Nothing further was heard of the venture until I saw Mr. Le Fevre's letter in the *Rangoon Times* of 31st August 1904. I have since been informed that altogether 2½ tons of fibre were cleaned and prepared by manual labour and disposed of through Messrs. Finlay Fleming, Edmund Jones and Deacon Clarke, of Rangoon. The price realised is said to have been £35 per ton in England or Rs. 5-8 to Rs. 6 per maund in Calcutta. Mr. Le Fevre was obliged to stop work as the help which he had been promised was not forthcoming.

OTHER PLANTS YIELDING SUITABLE FIBRES.

HIBISCUS CANNABINUS, L.

The Mesta-pat of Bengal could be cultivated perhaps more extensively than Thinban Shaw, and in drier parts of Burma. This plant is already profitably cultivated in Vizagapatam district, Madras Presidency, and has been placed on the home market as a special kind of jute—Bimlipatam jute. (See No. 11, Agricultural Ledger, 1903.)

ABROMA AUGUSTA, LINN. F.

This sterculiaceous plant is mentioned on page 241 of the ledger referred to above. It grows in the Darjeeling Terai and possibly also occurs in South Tenasserim. It has not yet been met with in Burma by the writer and has apparently not been recorded from this Province.

VILLEBRUNEA INTEGRIFOLIA, GAUD.

(Kurz Flora, Vol. II, page 427, under Orcocinde sylvatica *Miq.*) The *Bourika* of the Assamese. The Nepalese name of this is *Lipia* and the writer knows the fibre to be excellent.

MAOUTIA PUYA.

Wedd. (Burmese *Sat Sha.*) Kurz on page 429, Vol. II, says this is frequent in the drier hill forests of the Martaban Hills at 2,500 to 5,000 feet elevation, often springing up in deserted hill taungyas, and that it yields a strong fibre resembling rhea. The writer knows this fibre also to be exceedingly strong and durable. For gunnies and similar uses it should fetch a higher price than that paid for jute bagging.

GIRARDINIA ZEYLANICA, DENEVAR HETEROPHYLLA.

The Nilgiri nettle. (Burmese *Petyagyi*, Karen *Latsa.*) This is plentiful in moist places *e. g.*, at Thagyo on the Kabaung river. The fibre which has been frequently reported on and exhibited, is very strong and durable and quite suitable for gunnies. The writer knows this fibre well and has had it made up into a coarse cloth, which is practically imperishable.

In the above list only those plants have been included which are not known to fame but which yield strong and durable fibres. If the gunny bag industry is successfully started the preparation of fine textile fibres and the utilisation of the waste tow, *e. g.*, for string, twine, paper-making, etc., is sure to follow. At the recent agricultural show of the Straits Settlements and Federated Malay States, held at Kuala Lumpor, it is said that a Mr. Schiemer has been very successful in preparing fibres by his new machine.

Mr. Le Fevre has been asked to prepare fresh samples of *Thinban Shaw* fibre for valuation as those previously prepared are not now available.

F. B. MANSON.

RANGOON: *Conservator of Forests,*

27th January 1905. *Tenasserim Circle.*

SCIENTIFIC PAPERS.

NOTE ON THE OCCURRENCE OF A PARASITIC FUNGUS ON PINUS EXCELSA.

BY W. MAYES, F.C.H., I.F.S.

When working last autumn in a part of the Kalela Reserved Forest in the Simla Division I noticed that a number of poles of *Pinus excelsa* had been attacked by a parasitic fungus, the fructification of which bore a close resemblance to *Trametes pini*, the well-known pest of the Scotch pine in Europe, with which those officers who have visited the forests of Prussia are doubtless familiar. Specimens of the fructification and of wood containing

the mycelium were sent to the Director of the Forest School, and were by him forwarded to the Cryptogamic Botanist to the Government of India. The latter officer has identified the species as *Trametes pini* itself.

This fungus is a true parasite, the mycelium growing in the interior of the living tree and producing red rot of the worst type. The wood becomes spongy and useless for timber, and exhibits numerous white-bordered cavities, the presence of which, as Dr. Butler informs me, is characteristic of *Trametes pini*, and of no other species. The spores obtain an entrance through wounds; and the sporophores appear on all parts of the tree-trunk, but show a decided preference for old branch-scars. They are bracket or horseshoe-shaped or rounded, generally small or of moderate size; and their colouration—blackish brown above and dull fawn below—makes them inconspicuous objects. My observations go to show that the mycelium lives in the heart wood rather than in the sap wood and cambium, with the result that, although the timber is rendered useless when once the fungus has obtained a firm hold, the tree is not killed quickly. This is in some respects a disadvantage, for it tends to give an infected wood a fictitious appearance of healthiness. For instance, the forest of which I am writing looks at first sight remarkably healthy and promising; and it is only when a closer examination reveals the numerous sporophores on the trees that the extent of the disease is realised. Fortunately *Trametes pini* does not attack the deodar at all, at any rate as far as my observations go. I have seen no instance of it, and the Range Officer states that he has not seen the characteristic red rot in the wood of any deodar tree that has been felled in the forest.

This occurrence of the fungus is of practical as well as scientific interest owing to the extent of the damage that has been and is still being done. Having been informed as to the identity of the species by Dr. Butler, I have lately made a careful examination of the affected area, with the result that a dense forest of *Pinus excelsa* poles covering an area of 181 acres has been found to be diseased beyond hope of recovery.

To obtain some reliable data I carefully counted the trees over an area of one acre in one of the best stocked parts, and found that out of 693 trees no less than 203, or say 30 per cent, were infected. These 203 trees were those which showed obvious signs of the disease in the shape of the sporophores of the fungus; but as *Trametes pini* does not fructify until its growth inside the tree is far advanced, there must be many more stems which are diseased but on which the sporophores have not yet appeared. Under the circumstances it is, I think, justifiable to assume that 40 per cent of the crop is already infected. Healthy and diseased poles are mixed together; the former have on them numbers of old branch-scars through which the spores can gain an entrance; and it is hardly to be supposed that any large proportion of the crop will ultimately escape infection. The only preventive measure that can be taken is to cut away every diseased tree as soon as the sporophores appear on it. If this were done it would mean cutting out nearly half the crop at once, and even then it is almost certain that the disease would not be extirpated. The poles are now about 40 years old, and in the ordinary course would have to grow for 40 years more to reach exploitable dimensions; but the balance of probability is that by the end of that time the great majority of them would be fit for nothing but firewood, even if they had not been thrown down by wind or snow owing to the spread of the fungus in the wood and the consequent rotting and weakening of the stem. Under the circumstances it seems that the only thing to do is to get rid of the present crop as soon as possible, and grow something better in its place; and I have already sent up official proposals for the conversion of the pine area into deodar. The method would be to make a severe thinning among the pine so as to remove about half the present stock, including if possible all the obviously diseased poles, and then to sow deodar in lines under the shelter of the remainder which would be removed gradually as the young deodar grew up. Under my proposals the sowing up of the whole area would be completed in 16 years, which is the period that the present working plan of the forest has to run.

I may add that I have lately observed *Trametes pini* in other forests besides Kalela, though not to the same extent. It appears that the fungus is an enemy to be reckoned with in all *Pinus excelsa* forests in the Simla hills; and it would be interesting to learn whether it has been observed in other parts of the Himalayas also.

ORIGINAL ARTICLES.

THE SCHOOL OF FORESTRY.

FOREST OF DEAN.

BY C. O. HANSON, I. F. S., RETD.

There has been so much written of late about the need for forest schools in England that it may be of interest to Indian Forest Officers to know what has actually been accomplished in this important matter by the Commissioners of Woods and Forests.

After the publication of the report of the Departmental Committee appointed by the Board of Agriculture to enquire into the state of British Forestry, the Commissioners of Woods and Forests determined to start a small school as an experiment. They decided that it should be in the Forest of Dean, as a large tract of woodlands was available for instruction and practical work. It was, moreover, decided that only working men should be admitted with the idea that, after going through the course, they would be suitable for the position of woodmen in the Crown Forests, or for woodmen or foresters on private estates.

The object of the school is to supply thoroughly practical men, not above doing manual labour, and, at the same time, with a thoroughly sound training in sylviculture. It was thought that such men would be useful both on small or large forest estates.

On the recommendation of Dr. Schlich, I was appointed Instructor, and the school was opened in January 1904 with a class of nine men of between 17 and 22 years of age. Seven of these were Crown workmen in the Forest of Dean and two were sent from Windsor Forest. In November 1904, a second class was

started with seven men, five of whom were Crown workmen and two came from private estates. In all there are at present 14 men at the school (two of the first class were found unsuitable and were dismissed). It is proposed to take in seven or eight men annually; the full course being two years. Each class attends school on two days in the week for three hours on each day, with an occasional full day in the woods on excursions or for practical work under my supervision.

The remainder of the week they are at work in the forest as ordinary labourers, and, though not then receiving instruction, they become fairly expert in much useful work. At such times they are employed on nursery work, planting, hedging, draining and the innumerable other operations which form part of the ordinary routine of forest work. In addition they are taught by experienced woodcutters to use an axe and saw.

With regard to class room work, I am the sole instructor, and the time at my disposal only enables me to deal with the most essential subjects. The majority of the men have done but little reading or writing since they left school at 14 years old, and a little general education, especially in arithmetic, would be an advantage; but until the school is enlarged and a second instructor appointed, it is impossible to do more in such subjects than to bring in what is absolutely necessary to render the lecture intelligible. If time permits the following subjects will be dealt with :—

1. Sylviculture, theoretical and practical.

2. Forest protection.

3. Measurement of felled and standing trees and woods.

4. Simple working plans suitable for the present state of the majority of small British wooded estates.

5. The felling and extraction of timber and preparing timber for sale.

6. Simple accounts and control books.

7. Elementary botany sufficient to understand the life-history of a tree, and the recognition of British forest trees and shrubs; the life-history of the more important fungi. The identification of the chief British timbers.

8. Entomology.—The life-history and identification of a few of the most injurious insects.

9. A short course of surveying.

The result of the first year's working is encouraging. The men are keen on the work, and have improved considerably in intelligence.

The school being in an experimental stage we have at present no school buildings or properly set-up class rooms. A room in the institute at Parkend, near Coleford, is placed at our disposal on school days. A small museum and herbarium has been started.

In course of time if the school is successful we shall probably be given proper accommodation.

The surrounding woods in the Forest of Dean, consisting of 18,500 acres, and especially the high meadow woods of 3,285 acres, which latter is now being worked under a plan prepared by the late Mr. H. C. Hill, afford ample instructional areas for the students to observe the growth of broad-leaved trees and larch. Unfortunately there are no woods of other conifers in the neighbourhood. There are a great variety of soils and situations, the land being hilly and varying from 100 to 900 feet in altitude and the soil being on four different geological formations.

I receive much help from Mr. F. A. Popert, Conservator of Forests (retired), who is Superintendent Forester here, and every opportunity is given me of instructing the students in practical work, thinning, pruning, etc., by Mr. Philip Baylis, Deputy Surveyor, under whose general orders I work.

The future of the school largely depends on whether the students find places after completing their course. The Crown will employ a certain number, but, of course, cannot employ all besides those actually at the school. As we are continually hearing that trained woodmen are unobtainable in England, one may presume that there will be no difficulty in getting places for the passed students, and that employers will be willing to give higher wages than are at present given to untrained men.

It must be very satisfactory to Dr. Schlich to feel that, at

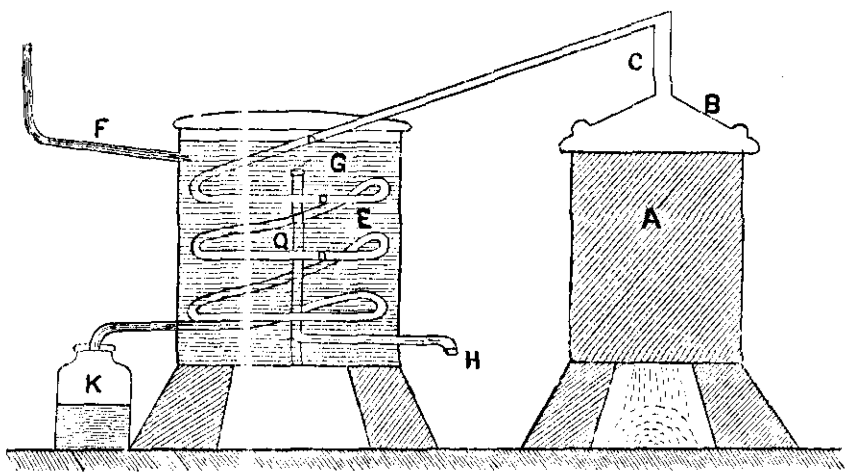
last, after his long continued efforts to improve British Forestry, a beginning, though a small one, has been made to educate the woodman class. It is perhaps hardly necessary to say that I have received a great deal of help and advice from him.

THE EUCALYPTUS (E. GLOBULUS) OIL FACTORY AT COONOOR, NILGIRIS.

BY K. G. MENOY, COCHIN FOREST DEPARTMENT.

This industry is carried on on a very small scale at Coonoor at the "Carolina" premises by Mr. Thomas Brown, the owner of the place

At present the industry is rather of the nature of an experiment than a lucrative business. The apparatus in use is comparatively simple, consisting of a still and condenser. The still is put up in a katcha building of small dimensions. A sketch of the still, condenser, &c., is given below. The still *A* consists of a big copper vessel of about 6 ft. in height and 3 ft. in



LONGITUDINAL SECTION OF THE STILL, CONDENSER, &C., USED AT THE EUCALYPTUS OIL FACTORY AT COONOOR, NILGIRIS.

diameter and is covered by a disc *B* penetrated at its centre by a pipe *C*, which carries the vaporous oil to the condenser *E*. The

condenser is a copper vessel of about equal dimensions to the *still* and contains a coiled copper tube *D*, which is continuous with the pipe *C*, and also a vertical pipe *G*. *E* is filled to the brim with cold water by means of a feeder pipe *F*, the heated water from the condenser being carried away through the tap *H*. The jar *K* receives the oil condensed in tube *C*.

The still is filled with well-matured leaves and water poured in to fill up the interstices. The vaporous oil carried by tube *CD* gets condensed in its course through the condenser and trickles down into the bottle.

About two head-loads of leaves go to fill one charge of the still, and it takes usually about eight hours to extract all the oil of one charge. The resulting oil is, with advantage, re-distilled to drive away any aqueous vapour and pyroligneous acid present in it.

Since Mr. Brown uses his own firewood it is not possible to fix the expense incurred by him on that score. It may, however, be stated that as since about 20 c. ft. of firewood are consumed to extract the whole oil from one charge, fuel to the value of Re. 1-4-0 is usually burnt away. One charge of the still gives 27 oz. of oil. Besides the expenditure on fuel a sum of Re. 1-8-0 per charge of the still is entailed for supervision and rent of premises utilised for the purpose. Hence the total charge per fill of the still is Rs. 2-12-0, giving thereby 27 oz. of oil.

Owing to the extreme cheapness of Australian oil which in Madras and Bombay sells at Re. 1 per bottle of 12 oz., the oil of Mr. Brown's factory does not command a ready sale, so much so that he had, at the time I visited his factory, about 1,000 bottles ready for the market. The selling price fixed by Mr. Brown is Rs. 27 per dozen bottles of 12 oz.

GIRDLING OF MISCELLANEOUS TREES IN SAL FORESTS.

BY F. F. R. CHANNER, I.F.S.

Many readers of the *Indian Forester* must have experience of this sort of work and must have noticed that girdling appears to have no effect on several species. As it is a great waste of time

and money to girdle trees which cannot be killed in that way, it is of the greatest importance that reliable information on the subject should be arrived at and made public. Organized experiment is a necessity—casual observation will tell one that trees of such and such species have not died, but no proof is afforded that all other trees of the same species have not died. The observer probably goes home and issues an order about insufficient depth of girdling. Much might be done by observing that certain species never occur among the dead trees, but it is by no means easy to distinguish the species of many dead trees.

Experiments were conducted in the Bahraich Division of the Oudh Circle last season, and I make the results public in the hope that observations in other places may come to light, and that before long it may be settled once for all which species should not be girdled. Further information is required about many species, particularly about the rarer ones, as the numbers dealt with were too small for any decision to be arrived at.

Species which do not die when girdled.

Dillenia pentagyna.	Eugenia jambolana.
Odina wodier.	Terminalia belerica.
Adina cordifolia.	Diospyros tomentosa.
Stephegyne parvifolia.	Mallotus philippinensis.
Anogeissus latifolia.	Sterculia villosa.
Spondias mangifera.	All species of figs.

Species which die when well girdled.

Bridelia retusa.	Bassia latifolia.
Buchanania latifolia.	Terminalia tomentosa.
Augeinia dalbergioides.	

Species which probably die, but more certain information is required.

Kydia calycina.	Saccopetalum tomentosum.
Garuga pinnata.	Hymenodictyon excelsum.

Species which probably do not die, but more information is required.

Lagerstrœmia parviflora.	Semecarpus anacardium.
Careya arborea.	Stereospermum suaveolens.
Grewia asiatica.	
Ulmus integrifolia.	

Information is required about—Schleichera trijuga, Miliusa velutina, Gmelina arborea, Elæodendron Roxburghii, Bauhinia racemosa, Bauhinia malabarica, Albizzia procera, Albizzia Lebbek, Cedrela toona, Cordia myna, Cordia vestila, Eugenia operculate. Many common species are omitted either because they are usually too small to come under consideration or because they do not actually occur among sal trees, but rather in patches from which sal is absent.

THE FIXATION OF SHIFTING SANDS IN MARWAR.

BY L. DAS, SUPERINTENDENT OF FORESTS, MARWAR.

Towards the north and west and south-west of Jodhpur the soil of Marwar is sandy, being a portion of the Rajputana desert. The sand is mostly of a shifting character, being blown across the country by the south-west winds of the summer, and frequently forms itself into hills of varying height. During the months of the year that the winds prevail, the blown sand is a serious nuisance in many ways, but chiefly on account of the great damage it does by spreading over the fields of the cultivator and the embarrassment it causes to the administration by accumulating on the Railway line and impeding traffic. To combat this latter annoyance the Darbar used to employ during the hot season a supernumerary gang of coolies to shovel away the sand as it accumulated over the line; but the arrangement was not only costly but at times unequal to the task of preventing frequent delays occurring to the traffic in cases where excessive accumulations of sand heaped up.

The nuisance is most felt in the area served by the Shadipalli section of the Jodhpur-Bikaneer Railway, *e.g.*, at Balotra station, where, although the line runs parallel to, and within a furlong of, the river Luni, the sand nuisance is hardly lessened owing to the bed of the river being dry for more than eight months in the year; on both banks the sand is almost as heavy as elsewhere. In 1901 the Marwar Darbar drew up measures to fight the sand by raising barriers against its progress. It was known that blown sand collects itself on the leeside of a barrier up to a certain height

and no further, and it was sought to train it so as to form a hillock which might gradually be consolidated by means of a plantation and forest growth. For the purposes of this experiment the belt of sand which divides the Railway line from the bed of the river Luni at Balotra was selected. A wooden fence being too costly, a 2 ft. high thorn-fence was placed immediately above the river bank and another a few yards short of the Railway line for a length of a quarter of a mile, similar fences being placed across so as to enclose about 20 acres of ground. The whole enclosed area was then strictly closed against the trespass of man and beast, the chaukidar even being forbidden to enter, lest he should break the soil and prevent the formation of a comparatively steady layer of rotten vegetation. Broadcast sowings were then made of *Babul* (*Acacia arabica*), *Khejra* (*Prosopis spicigera*), *Madar* or *Akra* (*Calotropis procera*), *Bhu*, Baveli (*Acacia Jacquemontii*), *Bhu*, *Rengni* (Solanum sp.), *Jharberi* (*Zizyphus nummularia*), &c. As soon as the fence on the river bank was covered with sand on the leeside, a fresh one was superimposed upon it; and this process has been repeated with the result that a ridge of loose or partially loose sand is now formed and promises soon to attain such a height that future sand drifts instead of crossing it will be beaten back into the river bed and washed away when the next rains come round. In the course of time, as the ridge becomes covered with wild vegetable growth and gains in firmness, it will form a fairly effectual barrier against the sand. Within the enclosed area beyond it is hoped by means of a growth of grass and shrubs to obtain a matted layer of roots and soil, dead leaves, &c., which will not only fix the sand but will enable more valuable species of trees to be put in and a valuable area of forest obtained. and thus for ever put an end to the nuisance of shifting sands near the Balotra station. The experiment in this double aspect has already been so far attended with success that the immunity of the Railway line from what at one time threatened to be an irrepressible evil seems assured; and the only pity is that during the last four years the rainfall has not been abundant enough to have already crowned the efforts of the Marwar Darbar with complete success.

SYLVICULTURAL NOTES ON HARDWICKIA BINATA.

FROM OBSERVATIONS MADE IN THE CUMBUM RANGE, KURNOOL DISTRICT.

BY E. M. CROTHERS, FOREST RANGER.

Hardwickia binata *(yepi)* is found in more or less all the reserves of the Cumbum Range. Various stages of growth are present from small seedlings to mature trees 6 ft. in girth, usually forming gregarious patches of large or small extent; in some reserves old isolated trees may be found amongst a thick growth of bamboos. A peculiar feature is that very few trees of 6 ft. girth are sound; this I should think is due to forest fires combined with the effect of a succession of dry hot seasons which must have caused cracks internally (cup and heart shakes), and as time went on these increased till the advent of fungi completed what drought and fire had left unaccomplished. In localities where excessive grazing has been going on for years on poor soil Hardwickia binata is represented by small stunted bushy growth.

Aspect.—I have seen Hardwickia on all aspects and doing very well so long as the soil is inclined to be sandy and deep; the underlying rock in all the reserves here is chiefly quartzite, which yields a reddish yellow gritty soil on which the growth of grass and other vegetation is not very profuse, and this seems to be the soil favoured by Hardwickia. I have never seen the tree growing in the immediate vicinity of streams, from which I infer that it does not care for much moisture in the soil, preferring rather a dry one.

Associates.—Hardwickia usually grows in a gregarious condition forming a pure crop, but in some localities it may be seen forming part of a mixed crop of many species, and on occasions it forms a very small proportion of the crop and is represented by old and hollow stems: on such areas I have not noticed many young trees. The only species in whose company Hardwickia forms a good mixed crop is *chiriman* (Anogeissus latifolia), the condition being that there must be only these two species on the ground (as occurs in some localities in this range). If advantage of this relationship between these two species

be taken, and if such localities where they are found together were to be put under special treatment by cutting out systematically all other species found on the area, it seems very possible that a crop could be obtained of these two species which could be treated as coppice with standards, the Anogeissus forming the coppice and the Hardwickia the standard; the latter would yield timber of large dimension whilst the former would give small sized timber and fuel.

Roots.—Hardwickia has a long tap root which runs down as directly as possible into the soil; in seedlings the roots are from two to three times the length of the portion above ground, though I cannot say definitely that this proportion is maintained in older trees; the tap root I should think is not very susceptible to injury because very often the sub-soil is full of loose boulders, large and small, and to make its way through these the root must often get injured; yet in such places Hardwickia seems to do well enough. To determine, however, exactly how much injury the tap root can stand would need a number of experiments consisting of cutting the tap root of a number of plants and watching the effects.

Reproduction by seed.—Hardwickia may be reproduced by sowings, if the seeds are deposited before the rains in a sandy soil with only a light cover of trees overhead. This conclusion I draw from the fact that when I was in the Ramallakota Range I noticed that before I began a felling in a crop of yepi, there were no seedlings on the ground (the fellings were conducted in February and March); the previous year's seeds must therefore have been on the area. After the rains when the coppice shoots began to sprout I noticed that there were plenty of seedlings as well, whilst in the unfelled area there were no seedlings, thus demonstrating that the cover (though light even there) was too dense.

The fellings provided that only eight of the best trees should be left per acre, which seems to suit Hardwickia reproduction by seed.

Coppice growth.—Hardwickia stumps throw up a number of shoots from about an inch below the cut surface of the stump; these shoots continue to grow up in a bush till one takes the

supremacy and the others then die down; this could be aided by cutting out the unpromising shoots and leaving the best one of each clump to survive.

Enemies.—In dry seasons when the monsoons fail Hardwickia seedlings and young trees stand in imminent danger of being exterminated by cattle grazing in the forest, because at such seasons the little grass that does come up is soon eaten and then the hungry cattle turn their attention to Hardwickia leaves, which they seem to enjoy; buffaloes more particularly prefer Hardwickia leaves to any other fodder.

Insects.—I have not noticed up to date any attacks of insects on living specimens of Hardwickia—not such as would damage trees to any appreciable extent; the wood in stacks, however, is readily attacked by bark and wood boring beetles, more especially the white sap wood.

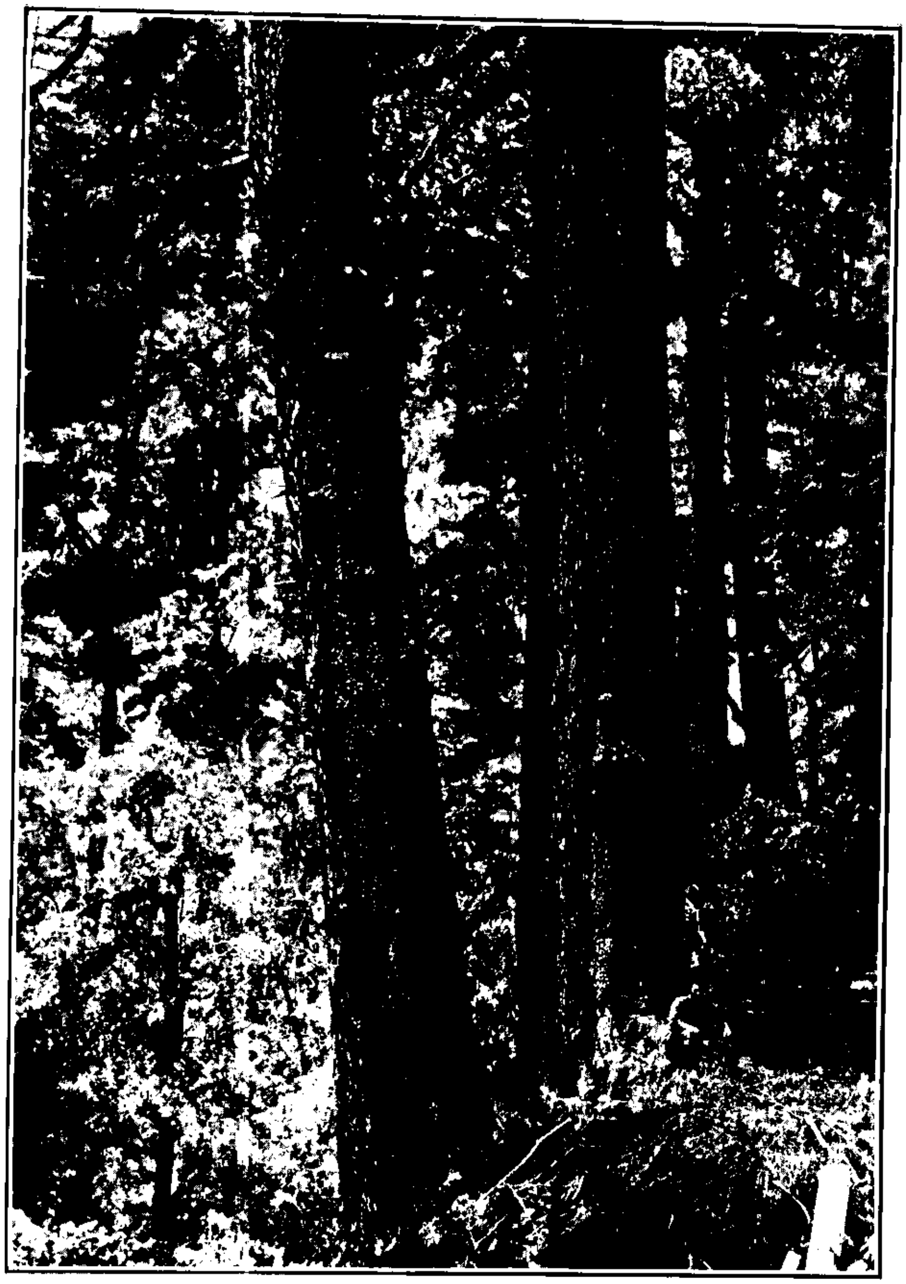
We trust the author will endeavour to procure specimens of these beetles for identification, since there are no reports extant of the wood being attacked by such and the observation is likely to prove of considerable importance. —HON. ED.

SOME LARGE DEODARS IN TEHRI GARHWAL.

BY J. W. OLIVER.

The two illustrations show specimens of particularly fine deodar trees growing on the right bank of the Dwanti stream in the Kulni forest, Tehri Garhwal, N.-W. India, where selection fellings were being carried out at the time the photographs were taken in May 1900. The deodars are mixed with Moru Oak (*Quercus dilatata*), which, while they have no doubt in a very great measure contributed to the excellence of size and quality of the existing crop of the former, render their reproduction a very difficult problem. The felling was followed by a good seed year, and at the end of 1902 there was an abundance of young seedlings on the ground It seemed, however, doubtful whether they would be able to struggle through the undergrowth.

We have referred this latter point to Mr. Tulloch, the Officer in charge of the area mentioned. He has very kindly sent us the following note:—"The seedlings



DEODAR, 24½ FEET GIRTH, WITH MORU OAK, DWANTI, TEHRI GARHWAL.

referred to come up well, but only survived in places where there was no grass or Indigofera. I had several patches marked in the grass to see if the seedlings would survive, but found that by the next year they had all died.'—HON. ED.

EXTRACTS FROM OFFICIAL PAPERS.

A LONDON REPORT ON BURMA WOODS.

I beg to send you, for what they may be worth, the enclosed copies of correspondence *re* a sample of consignments of certain woods of South Tenasserim.

The writer of the "Report on Burma Woods" has an extensive vocabulary of depreciatory terms but, to my mind, shows little knowledge of the timbers in question or the special uses to which they might be put as ornamental woods. This one is regarded as a substitute for teak, that as a substitute for ebony. Had a reference been made to Gamble's *Manual of Indian Timbers*, Laslett's *Timber Trees* or some other good book on the subject, the writer might at least have concealed his ignorance. I submit that it is a waste of money to send samples of timber to London only to be informed what is thought of the colour, texture, shakes, cracks and other defects; to learn that it is undesirable that a wood should be "wild-grown," that those who report on the prospects of a trade in the woods sent to them have no conception of their use except as a substitute for a timber already on the market, and evince no interest in discovering what they are fit for. It is a pity that some retired Forest Officer with a good knowledge of Indian timbers cannot introduce some of them to the small industries which use ornamental woods. It is, of course, desirable that the samples sent should be of good quality and attractive in appearance: but except for an international exhibition, large squares cannot be wrapped in paper or packed in cotton-wool, and

I doubt whether, for commercial purposes, it is wise to send too choice a sample either as regards size or quality. These samples should be of a good average quality which can be supplied in quantity. It is desirable that they should be consigned to some one who will take the pains to work up the woods, discover the special purposes for which they are most fitted, exhibit them *attractively to consumers, and push their sale. On the other* hand, the consignor should be able to give information as to supplies available and probable price. It is perhaps natural that a firm interested, say, in padouk, teak or mahogany should not take any trouble to introduce a substitute for the article in which they trade, though it is possible that they might make large profits on the substitute. I think Government would derive more profit from appointing capable agents in England than from equal expenditure upon exhibitions

RANGOON : F. B. MANSON.

April 1905.

Endorsement No. 1058/2T., dated 7th February 1905, by the Divisional Forest Officer, South Tenasserim.

Copy of the following forwarded to the Conservator of Forests, Tenasserim Circle, for information.

Letter No. 360 dated 6th January 1905, from Messrs. Gillanders Arbuthnot & Co., Calcutta, to the Divisional Forest *Officer, South Tenasserim.*

We have the honour to enclose copy of a report of a small parcel of miscellaneous timbers received from you and sent to London for examination. These are the timbers referred to in your No. 77 of 29th April 1904.

We regret that they do not appear to suit the requirements of that market or to hold out any promise of developing a business in them.

London, 8th December 1904.

REPORT ON BURMA WOODS.

The two Che logs are of reddish colour, somewhat similar to the inferior varieties of Padouk ; they are straight and well made but somewhat end-shaken.

The two logs of Gangaw are of coarse texture and somewhat similar in colour to the Che logs; they are very sappy, also rather waney and end-shaken.

The Sinkosi log is of brownish colour, somewhat similar in grain to oak; the log is, however, wormy and very sappy. Not an attractive sample.

The Taungbog log is of soft texture and bluish-grey colour; it is straight and fairly well made, but badly ring-shaken.

The Kinthat is of mild texture and brownish colour; it is, however, an inferior log, being waney, knotty and very grubby.

The Thitkado log is in colour somewhat similar to cedar, but the grain is coarse; the log is fairly sound but wild-grown and waney.

The Thitka log is of usual reddish colour and close texture; it is well made, straight, and fairly sound.

The two Kanzaw logs are of reddish colour, somewhat similar to mahogany but of coarse texture; they are straight and well made but seriously side-shaken, being very shelly.

The Karawe log is of mild texture and reddish-brown colour; it is fairly well made but rotten at one end.

The Anan log is of light-brown colour, sound and well made.

As regards the prospects of the above logs, there is little to recommend any of them. The Che and Gangaw logs might possibly serve as substitutes for Padouk if this were scarce, but not in competition with the African variety, which is heavy in stock at the present time, and is sold with difficulty at about £3 per ton. The Thitka, Thitkado and Kanzaw are likely to be difficult of sale, African mahogany of similar size and better quality being easily obtainable at 2½d. per foot. The Sinkosi appears of fair character, but is not of equal merit to the sample sent some time back. The Taungbok, Kinthat, Karawe and Anan, however, have no attractive features, and we do not see any opening for them, the first being useless as a substitute for ebony, and the second equally so for teak.

[We understand from the Conservator that he was unable to himself personally inspect the logs before they were despatched to London. It is a commonly known

fact that the London dealers do attach the very highest importance to the external appearance of a log, and an inferior log with trimmed ends would in most cases probably sell better than a finer one whose ends were in the rough condition they had left the forest in. No one is more fully aware of this than the Burma Timber Companies, who pay the greatest attention to such niceties. That there are good men in London cannot be doubted by those who have read the series of articles on "New Woods", reproduced at pp. 108 and 177 of this volume. It is with such men, not only in London, but at all the important forest produce-importing trade centres throughout the world, that we, through the medium of an Economic Research Bureau, should be able to get into touch with.—HON. ED.]

DISCONTINUANCE OF THE CULTIVATION OF THE EDIBLE DATE IN MADRAS. *

The following extract from the Report of the Superintendent of the Government Botanical Gardens at Saharanpur appeared in the *Pioneer*:—

"There are two matters which call for notice in the report on the acclimatisation and other experimental work carried on at the Government Botanical Gardens at Saharanpur. Considerable experiments have been made with the cultivation of the Arabian date-palm, and the Superintendent now states that while date-palms with ordinary care thrive well in the soil of Saharanpur, and may be cultivated for landscape or ornamental effects, they are of little or no use as fruit or food-producing trees. Even in abnormally dry seasons one or two small showers of rain are sufficient to destroy the bulk of the fruit, and it is only in the event of an almost complete failure of the monsoon—fortunately not probable in any part of the Province—that the fruit might be expected to ripen to perfection. The date-palm can only be expected to be a success as a food-producing tree where there is hardly any or no summer rainfall, and yet sufficient water to supply the roots with a fair amount of moisture throughout the summer."

Mr. A. W. Lushington, Conservator of Forests, Northern Circle, Madras, in drawing the attention of his Government to this extract enquired whether, since edible dates were bound to fail as

* From papers placed at the disposal of the Hon. Editor by the Government of Fort St. George.

food-producing trees in a country when there was the smallest amount of rain during the fruiting season, it was advisable to expend any further sums on the experiment of the cultivation of the tree. The Commissioner of Revenue Settlements and Land Records referred the matter for report to the Deputy Director of Agriculture and the Government Botanist. The former concurred with the opinion of the Conservator.

Mr. Barber in a memorandum considered the subject at some length, pointing out that the date-palm was an inhabitant of the so-called "rainless tracts" of the earth, requiring a dry heat with a daily maximum of 100° F. from May to October when its fruit is ripening. A rainfall of 5–10 inches in the year is sufficient, but should not occur during the fruiting period. A daily variation of temperature, such as occurs in desert regions (and this is frequently very wide) would not be injurious, but although frost is not harmful more than 10° below freezing point should be avoided. With this dryness of the atmosphere the tree requires an abundant supply of readily available sub-soil water or the means of ready irrigation with perfect drainage. A valuable property of the tree is its remarkable indifference to soils heavily charged with alkali, and it is said that it can even thrive when irrigated with water so full of brine as to kill all other trees and crops.

Having fully considered the reports before him the Commissioner of Revenue Settlements and Land Records was of opinion that it was inadvisable to continue the experiments in the cultivation of the date as a food-producing tree in the Presidency.

SCIENTIFIC PAPERS.

THE RIPENING OF THE CONES OF PINUS LONGIFOLIA.

ON THE FORMATION OF PSEUDO-CONES OR GALLS.

BY BABU BIRBAL.

This subject has been discussed in the pages of the *Indian Forester*; and I now beg to give below the results of my further researches on this subject.

1. In April 1903, Vol. XXIX, page 276, Mr. E. M. Coventry wrote a note on the subject of the ripening of the cones of P. longifolia, in which he said "There appears to be a mistake in Gamble's *Manual of Indian Timbers*, page 706, regarding the period necessary for the cones of chil (P. longifolia) to ripen; this is given as 15 months, but I think it should be a year longer." He also wrote, "according to Kangi Lal's 'Flora of the School Circle,' the chil (called chir in that circle—Hon. Ed.) flowers in February—April and the seeds are shed in October next year. In this Division (Kangra) the seed falls from the cones in May."

2. To this letter I replied in July 1903, page 407, that the fruit takes 12 to 15 months to ripen and the seeds are wholly shed in May of each year in Dehra Dun, and that there is an exception to this rule; that the cones of which the ovules are not fertilised being weakly ones do not open and therefore cannot shed their seeds and remain unopened on the trees and during the rains decompose or decay.

I asked Mr. Coventry to send me specimens of cones which take 2¼ years to ripen in order to enable me to ascertain their age.

3. In December 1903, page 572, Mr. Coventry, in reply to my letter, wrote "Last year's shoot terminates in a bud. In March or April this bud expands and develops into a shoot, which bears at or near its extremity the young cones. When the shoot has expanded to its full length, it is found to be terminated by a bud, round which the young cones are situated. The male cones are situated on and around the lower portion of the year's shoot and

drop off soon after they have shed their pollen. (Male and female cones do not of course occur on the same shoot.)"

Further on Mr Coventry says, "At this time of year (September) only two kinds of unripe cones are found on the trees, *viz*:—(a) this year's cones at the end of the shoot and surrounding the terminal buds. These are now brown externally but are green within. Next spring when they enlarge they will have the appearance of (2) above. (b) The cones at the base of the current year's shoot. These have nearly reached their full size but are still green except the tips of the scales. They have become fairly hard. I have sent to the Forest School a branch which bears cones (a) and (b). All the Rangers in this district and some zamindars whom I have questioned state that the cones require two years to ripen."

4. In December 1903, page 573, Mr J. C. McDonell, late Conservator of Forests, Kashmir, drew attention to a previous note of his own (*Indian Forester*, May 1886) in which he had drawn attention to the fact that the cones of P. longifolia take 29 months to ripen.

5. I answered the above letter, Vol. XXX, page 308, illustrating both kinds of cones by means of photographs showing that the real female cones were at the base of the flowering stock with plenty of male catkins above them to shed their pollen and to fertilize the female cones below them and close to them. I also drew attention to the fact that the female cones of a week old were 1½ inches long and the cones of 2 weeks old were about 2 inches long, and said that the growth of the cones after fertilization was extremely rapid, while the unfertilized cones were very small and were always found on the tips of the flowering shoots, and therefore their fertilization was quite impossible, as there were no male flowers close to them. I also drew attention to the fact that the distance between the cones produced each year was 14 inches; the question was then, how was it possible that the cones on the top of the flowering shoot and those at the base of the same flowering shoot, a distance of 4½ inches, were formed in two different years? That is, that the cones at the base were

fertilized one year and the two cones on the top fertilized the next year, which seemed to me impossible.

In paragraph 8 I said "Now, suppose cones are produced this year and are fertilized next year by new catkins, the distance between the two, as already explained, would be about 14 inches (see figure 13), which is to my mind too far to allow of proper fertilization. On the other hand, in case they be fertilized the same year as they are produced, there is no reason why they should turn hard and brown the first year and become again green and soft the following year and continue to grow, reaching, in a month or so, their full size. It is generally the natural rule that if any fruit is formed it grows regularly to its full size without any intermediate obstruction such as would happen in this case."

I would also draw attention to paras. 9, 10, and 11 of this letter.

6. In September, page 421, Mr. F. B. Manson, Conservator of Forests, in reply to my letter drew attention to a very important fact, *viz.*, that in the case of most *pines* fertilization of the ovules takes place *some time* after the pollen has been shed.

7. I was not satisfied with Mr. Manson's letter, as I still could not understand why ovules of Pinus longifolia cones should take one year to be fertilized. I also found it difficult to understand why cones of Pinus longifolia should get brown or yellow and decayed in the first year, and then in the following one, as the male catkins appear and the pollen begins to be shed, that the female cones become green and grow in two months or so to their full size and then turn brown and ripe and shed their seeds in May of each year.

I had shown some of the small cones at the top of the shoots to Dr. Butler, Cryptogamic Botanist to the Government of India, and asked his opinion, and he said he thought it might be due to some insect, but that it had nothing to do with a fungus.

I continued my observations till Mr. E. P. Stebbing, Forest Entomologist to the Government of India, returned to Dehra from furlough. I took some of the small cones to him for microscopic examination on the 14th September 1904, and he

examined the cones and found three grubs in one of these so-called cones. The grubs were found at the base of the scales where they were yellowish. Mr Stebbing said that the cone was a gall or false cone. I took some of the false cones on the 29th September 1904, when they were about ½ inch long and about ½ inch diameter, and put them in an insect-rearing box covered with muslin cloth and labelled them. These cones came to nothing and dried up in course of time. I took others again on the 24th October 1904, they being then about ⅞ inches long, about ⅞ inches diameter, with swollen scales of irregular shape, *viz.*, in some places these scales were very thick and in some places the scales were of the same size as on the 29th September. On the 29th November 1904, four flies issued and a number of grubs came out of the cones and turned into cocoons in about two days. On the 29th November 1904 I took a number of these galls and placed them in the insect-rearing boxes. On the 5th December 1904, lots of grubs came out as the galls were opening and many of the grubs turned into cocoons on the 6th December 1904, that is, *in two days only.*

I had also numbers of these cones enveloped in muslin cloth bags on the trees, and the grubs came out of the galls in the same manner as in the boxes and formed cocoons on the cloth and galls itself but not in the galls.

The flies began to issue from the cocoons on the 28th February 1905 and continued to issue till 19th March 1905. These are of two kinds, one with yellow legs and one with colourless legs.

In conclusion I beg to say that these galls of P. longifolia are formed on the needles and on the tip of the flowering stalks, and not in the male flowers. Figs. 12, 13 and 14 of my article in the *Indian Forester* for July 1904, page 108, will show that these so-called cones began to form when the male catkins had disappeared and the needles had begun to form. The real cones are to be found at the base of the flowering stalk and close to the male catkins, as figs. 1, 2 and 3 show.

8. The first appearance of the real cones of P. longifolia, which are then green, was observed on the 10th March, and by the

end of May they had nearly reached their full size but were still green, that is, in about three months. The seed is collected in the following May, as we have been doing during the last 20 years.

In conclusion I trust the above note will finally set at rest the vexed question of the ripening of P. longifolia cones. Mr. Stebbing has kindly promised to write a note upon the insects.

ON THE CECIDOMYID (CECIDOMYIA (?) SP.) FORMING THE GALLS OR PSEUDO-CONES ON PINUS LONGIFOLIA.

BY E. P. STEBBING.

Although I had followed the correspondence carried on in the columns of the *Indian Forester* on the subject of the ripening of the cones of Pinus longifolia, assuming the question to be rather a botanical than an entomological one I made no special study of the cones until Babu Birbal brought me some to examine on September 14th, 1904. I propose to deal here with the results of that examination and with the discoveries which Birbal's subsequent investigations, in which I was able to take part up to the end of the year, gave rise to.

A careful dissection, on September 14th, of several of the cones failed at first to show anything in the nature of an insect within them, although the structures, whilst very far from being so obviously galls as is the case, *e.g.*, with the Himalayan Spruce gall (*Chermes abietis-piceæ*), nevertheless certainly had not the appearance usually pertainable to cones. Closer examination finally brought to light some minute colourless grubs feeding in the mass of tissue which composes these structures. These larvæ under the microscope proved to be very immature maggots, apparently dipterous.

This settled the question as to the real nature of these structures which had up to now been taken to be cones or aborted cones, and steps were taken by Babu Birbal to keep them and the trees bearing them under a strict surveillance.

An examination of some of the galls the following month showed that they had slightly increased in size whilst the grubs were also slightly larger. Towards the end of November the larvæ commenced to reach maturity, and at the end of November

and through the first week in December they were to be found leaving the galls and crawling to the outside to pupate. It was at the end of November that it was first discovered that there was apparently another insect present in addition to the one responsible for the formation of the pseudo-cones, a hymenopterous fly, evidently parasitic upon the gall-maker; a fly issued from one of the galls. This fly will be alluded to at a later stage of this note. Babu Birbal obtained the real gall-makers at the end of February, and I was able to determine them as a species of *Cecidomyiid*.

Before dealing more fully with the life-history of this minute pest, as far as it is at present known, it will be necessary to describe the various stages of the insect obtained.

CECIDOMYIA (?) SP.

THE LONG-LEAVED PINE GALL-FLY.

Larva.—When examined in September the grub is a minute colourless maggot pointed at both ends, with a few small tubercles on it.

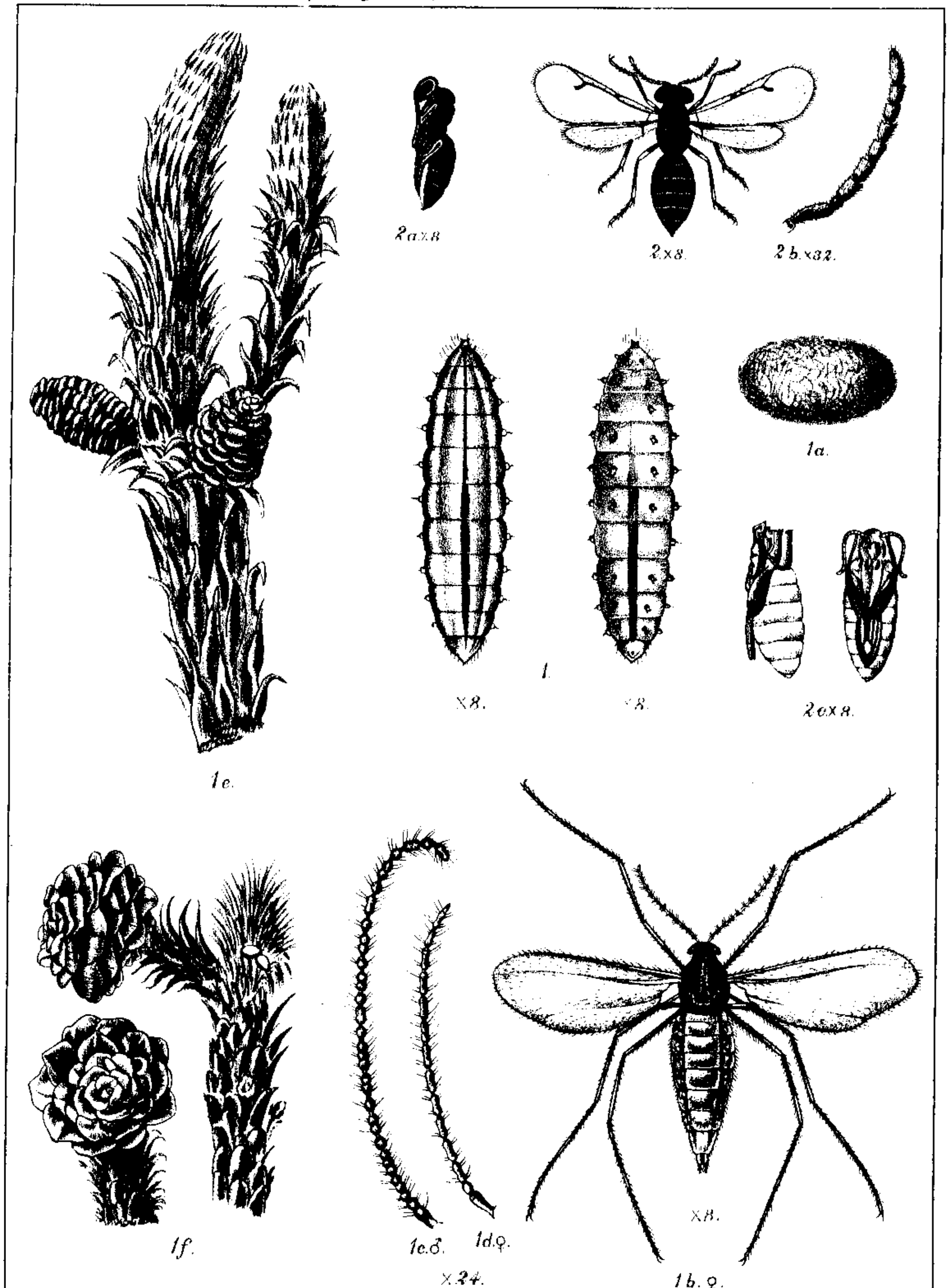
When full-grown the maggot is yellow to orange in colour, elongate-elliptical, flattish, the segments being set with numerous prominent tubercles length 4·7 to 5·4 millim.

Plate XXXVIII, fig. 1, shows a dorsal and ventral view of this grub.

Cocoon and Pupa.—When full-fed the larva leaves the gall and crawls to the outside and pupates there, forming a glistening white cocoon of a curious close matty substance. Within this the maggot pupates, the pupal skin being yellowish to yellowish-brown. The outer surface of the cocoon subsequently changes to yellow; length 3·2 millim. (Cf. figs. 1 a, 1 f.)

Imago.—A small delicate greyish fly with black eyes, long antennæ and very long legs.

Head small, black, with prominent eyes; antennæ long and furnished with whorls of simple hairs. The thorax is blackish-grey, broader than the head and bears the three pairs of long legs and a pair of delicate membraneous wings which have only two main nervures in them, the upper being the stouter; the halteres are long, the capitate body not being prominent. The abdomen is



S. B. Mondul, del. Lith: by S. C. Mondul.

The long leafed pine gall-fly and its parasite.

fairly stout, elongate, convex above, the first segments broadening out to 4th, which is broadest, and then constricting posteriorly; colour greyish with darker markings above; lighter coloured below. Legs grey and very long. Wing expanse 6·25 millim.

The antennæ in ♂ are 24-jointed, in ♀ 14-jointed, and shorter than in male. The male antennæ are curious in that many of the joints appear double or treble owing to constrictions in the joints themselves. Fig. 1 b shows a dorsal view of this insect, enlarged. Fig. 1 c shows an enlarged antenna of the male and 1 d of the female insect.

LIFE-HISTORY.

The eggs are evidently laid by the fly in the axils of the bud scales at the end of the shoot. In the long-leaved pine there is a terminal bud surrounded by 5 to 7 others. Three, four, or more of these may have eggs (or an egg) laid on them in this way. The larvæ on hatching out commence to feed in the green tissues and set up an irritation which evidently leads to the young needles swelling up and coalescing, thus forming the young gall. In September these galls are barely half an inch in length by one-third in breadth (*vide* fig. 1 e, which shows two of the galls). Externally they have the appearance of small cones, the minute scales being narrow and triangular shaped, the beak bluntly pointed. Sections cut through them fail to show any system of compartments, but merely a mass of green resinous tissue of considerable density. In this mass the young larvæ are living and feeding. At this period the maggots are only just visible to the naked eye. During October they increase in size, become yellowish in colour, and are to be found feeding at the base of the scales, embedded in a mass of turpentine. By the end of the month the larger of the galls are about ¾ inch in length, the scales having swollen on one or more sides to a considerable extent, their upper margins turning slightly over and downwards. The cones are elliptical or ovoid in shape. During November the grubs complete their growth in size, and towards the end of the month commence to leave the cones. These latter are by now just under the inch in length and about ¾ inch in breadth, the size of course varying. The scales have

swollen up to such an extent that their upper edges have deflected completely downwards, rolling up on to the under surface beneath (*vide* fig. 1 f). A large amount of turpentine and resin is exuded at this period, the whole forming a sticky mass. The grubs now crawl out from the interior of the cone and proceed to pupate either on the gall itself or they crawl to any neighbouring dwarfed buds and pupate amongst the scaly needles or amongst the scales on the twig itself. This wholesale exit on the part of the grubs is a most curious sight to watch and a peculiar feature of the life-history of this insect. It is doubtless determined by the fact that if they remained within the gall the mass of turpentine it now contains would on congealing eventually prevent the egress of the delicate flies. From Birbal's observations it apparently takes the grubs two days to perfect their cocoons, the external coating of which is not unlikely to be found to be some sort of exudation. The grubs began to issue from the galls on the 29th November and continued to do so until the 10th December, by which date all had pupated. They moved about very slowly, seeming to slowly glide or slide along in the turpentine which coated the galls. These latter covered with the bright yellow grubs presented quite a remarkable sight.

The first flies issued on the 28th February and continued to issue until the 19th March, the pupal stage thus lasting some three months.

The gall quickly dries up after the grubs have left it, but persists on the tree for a considerable time.

The life of the fly after issuing is probably a very short one, and the eggs are deposited, as above-mentioned, down at the base of the scales on the young buds of the year.

Although, owing to Babu Birbal's commendable persistency in continuing his investigations into the real nature of these cones (false cones as it turns out), we are now in possession of a considerable proportion of the life-history of this insect, indefiniteness still enshrouds other portions. We have yet to find out when the eggs hatch out and how long the larvæ take to form the pseudo-gall. The long-leaved pine puts forth its new shoots in March in

Dehra, and therefore long ere this the eggs must have hatched and the young larvæ have commenced to feed upon and abort the buds containing the new needles. The curious point, however, is that if the larvæ commence work, as is most probable, in April, how is it that the young cones are still so small in September, and also how is it that the maggots themselves are so tiny in this month? A possible explanation of the latter is as follows:—In the case of some cecidomyiid flies the females lay a few very large eggs, out of each of which comes a larva. This latter produces in its interior young larvæ which, after consuming the interior of the body of the parent, escape by making a hole in the skin, and thereafter subsist outside in an ordinary manner. Whether such a state of affairs applies to the P. longifolia cecidomyiid gall has yet to be ascertained.

THE INSECT PARASITIC UPON THE P. LONGIFOLIA CECIDOMYIA.

I have alluded above to the fact that two insects were found in the pseudo-cones. The second one proved to be a parasitic hymenopterous fly* belonging to the family *Chalcididæ*.

TRIGONOMERUS SP.

A small brilliantly coloured fly. Head metallic coppery-green with a brilliant irridescence, eyes large, blue-black, antennæ 10-jointed, dark brownish-black, thickly clothed with a short whitish pubescence, 1st joint longer than 2 and 3 together, scimitar-shaped, yellow, 2, very short, globular, 3, longer, broad, truncate at top, rest shorter than 3, subequal, except 9, which is slightly longer, truncate, 10 shorter than 9 and produced to a point at tip. Thorax metallic coppery with a brilliant irridescence and greenish sheen; deeply channelled rugulose, with a few large shallow punctures. Wings yellow and irridescent. Body dark blue-black. Under surface coppery; body blue-black. Upper and under surface with a sparse short stiff white pubescence. Legs canary yellow, pubescent. Wing expanse, 2·34 millim.

Fig. 2 shows a dorsal view of this insect, 2 a, a side one, and 2 b an antenna greatly magnified.

* This fly has been very kindly identified for me by Col. C. T. Bingham as an undescribed species of *Trigonomerus*.

Pupa.—Figure 2 c shows a dorsal and side view of the pupa of this insect. The pupa is whitish-yellow with black markings.

LIFE-HISTORY.

Beyond the dates of emergence of this fly and its evident parasitic nature upon the Cecidomyia we know little about the life-history of this useful insect.

Babu Birbal mentions obtaining four flies from the cones on the 29th November. As however only one of the flies was secured and subsequently identified the rest getting away, the latter must be eliminated from the enquiry altogether. No further flies emerged until March, when they issued in conjunction with the Cecidomyia. I am quite unable to account for the emergence of the November fly, as it would appear, according to the dates of emergence of the others, to be quite abnormal, and moreover equally useless since in November-December there would evidently be no Cecidomyiid eggs or larvæ for it to lay on or in.

EXPLANATION OF PLATE.

Cecidomyia (?) sp.

Fig. 1. Dorsal and ventral view of larva.
1a. Cocoon.
1b. Imago dorsal view
1c. Antenna of male.
1d. Antenna of female.
1e. Branch of P. longifolia showing two pseudo-cones in October.
1f. Side and front view of fully grown galls. The small white oval bodies seen on the scales and on the spiny tuft to left are cocoons.

Trigonomerus sp.

Fig. 2. Dorsal view of imago.
2a. Side view of same.
2b. Magnified antenna.
2c. Ventral and side view of pupa.

The sizes of the magnifications, if any, are shown by small numbers against the figures.

ORIGINAL ARTICLES.

THE EFFECTS OF THE GREAT FROSTS ON THE FORESTS OF NORTHERN INDIA.

A NOTE ON THE EFFECTS OF THE ABNORMAL FROST ON THE FORESTS OF THE DUN.

BY E. R. STEVENS, I.F.S.,

OFFG. DEPUTY CONSERVATOR OF FORESTS, DEHRA DUN DIVISION.

About seventy-five per cent of the forest-clad area of the Dun suffered considerably from the abnormal frosts during January and February of this year.

The damage naturally varies much with differences in aspect, density of the crop, and especially in elevation.

Only the tree growth on the higher slopes of the Siwaliks escaped injury altogether, and during March and April before the outburst of the fresh flush of sal leaves the frost limit was curiously and sharply defined by the dead and brown foliage of the greater mass of the forest suddenly giving place to a belt of green lining the upper slopes to the watershed.

With due regard to the varying intensity of the damage owing to the above mentioned factors it may be said that all young woody growth with but a thin protective layer of bark has been destroyed. This refers to the sal and its congeners with the exception of *Ougeinia dalbergioides, Dalbergia sissoo, Cedrela toona,* and *Mallotus philippinensis,* which suffered no serious injury. Thus the twigs and thinner branches of the older trees have been killed, and these trees now present a stag-headed appearance with the new foliage covering the main branches.

Poles from 1 to 2 feet in girth have been killed to within 5 to 15 feet from the ground, while those under 1 foot in girth have been killed to within a few feet from or down to the ground itself. New shoots are now being freely sent out below the dead wood, which will result in a large number of pollards, and as regards the future quality of the forest, this partial dying of the stem is the

most to be deplored : these stems which have been killed down to the ground are now sending up strong shoots from the roots

Coppice areas have naturally suffered very severely.

Young seedlings in fairly dense forest seem to have mostly escaped.

The injuries that the forests have sustained must represent the loss of at least 10 to 15 years' growth.

ON THE EFFECTS OF THE FROSTS ON THE TREES IN THE SAHARANPUR FORESTS.

BY L. A. COURTHOPE, I.F.S.

ASSISTANT CONSERVATOR OF FORESTS, SAHARANPUR DIVISION.

In the early part of this year, 1905, the Saharanpur District, in common with all Northern India, was visited by a spell of severe frost, almost unprecedentedly low temperatures being recorded. The immediate effect of this on forest growth was seen in the withering up of the leaves of trees of almost all species. This was most noticeable at the lower elevations, all the plains forests presenting a uniform brown appearance. From the foot of the hills, as the elevation increased more green trees appeared until near the ridge the effects of the frost could be seen but slightly. Viewed from a distance this counter influence of elevation against the destructive effects of the frost was most marked, the green and withered trees appearing to be separated by a clearly defined line along the hill side.

It was not until about May, however, that it was possible to form any correct idea of the extent of the damage. Then it became possible to see what trees were dried up completely, root and branch, what trees had been partially damaged, and what trees had escaped altogether.

The effects of the frost on sal poles, saplings and seedlings, which form by far the greater part of the sal stock in the Division, have been most disastrous. Even as the first effects were most noticeable at the lower elevations, so here too the permanent damage proved worst, being most conspicuous at Dholkhand, the central range of the Division. The seedlings have dried up altogether, the saplings have either dried from the ground upwards, in which

case they are sending out shoots from their roots, or they have been killed from the crown down to a varying distance, in which case their boles are surrounded by a mass of epicormic shoots, above which the dry stick which formed the leading shoot before protrudes. The poles are in very many cases damaged in the same way. The older trees now show no effects at all.

It still remains doubtful what the after effects of this damage will be. It is stated by some that when the dried part falls off, one of the epicormic branches will assume the lead, in which case after a few years very little perceptible difference would be seen. Others believe that several of the epicormic shoots will assume the lead simultaneously, thus causing a sort of pollard.

The sal has been made the chief subject of this note, as it is the most valuable species in the Division, and naturally more attention is paid to it.

The other species suffered most in the rather open plains forests, and least where they were growing mixed with sal. A list showing the comparative damage done to them is appended below.

The effects of the frost in the coppiced areas is more evenly distributed over the Division. In all the more recently felled areas the shoots of most species have been killed back, and new shoots are now appearing. The damage will be imperceptible after a few years. In the older coppices there is, I think, very little permanent damage, only a few trees here and there having been killed.

In some places this year's bamboo shoots have suffered and are drying up.

Another effect on the forest has been found in the absolute dearth of seeds of all kinds in the Dholkhand Range, while in the other ranges they are very scarce. This is due, of course, to the fact that the inflorescence was killed at the time of the frost. For this reason, too, there is but a small quantity of honey in the forests this year, for, while probably many of the bees died from cold, the survivors have not found sufficient flowers for the production of the usual quantity of honey.

The following is a list of those trees which have suffered most :—

Sal	... ...	*Shorea robusta.*
Chilla	... ...	Casearia tomentosa.
Pial	... ...	Buchanania latifolia.
Amaltas	... ...	Cassia fistula.
Ambasa	... ...	*Spondias mangifera.*
Kharpat	... ...	Garuga pinnata.
Bhandair	... ...	Zizyphus xylopyra.
Kura	... ...	Holarrhena antidysenterica.
Jingan	... ...	Odina wodier.

The following have suffered in a less degree :—

Khair	... ...	Acacia catechu.
Aonla	... ...	Phyllanthus emblica.
Pula	... ...	Kydia calycina.
Dhak	... ...	Butea frondosa.
Tendu	... ...	Diospyros tomentosa.
Jaman	... ...	Eugenia jambolana.
Shisham	... ...	Dalbergia sissoo.
Haldu	... ...	Adina cordifolia.
Pipal	... ...	Ficus religiosa.
Bargat	... ...	*Ficus bengalensis.*

NOTES ON THE EFFECTS OF THE SEVERE FROST ON CERTAIN TREES AND SHRUBS IN THE AGRI-HORTICULTURAL GARDENS AT LAHORE.*

The effects of the severe frost were very noticeable on many trees and shrubs of large size which hitherto have not been affected, and many trees and shrubs suffered very severely.

The following trees and shrubs which ordinarily are never affected by frost were slightly damaged, but will recover :—

TREES.	SHRUBS.
Michelia champaca.	Heliotropium,
Pterospermum acerifolium.	Artabotrys odoratissima.
Bursera serrata.	Hibiscus splendens.
Saraca indica (asok).	Sophora japanicum.

* *Communicated by the Inspector-General of Forests.*

TREES.	SHRUBS.
Barringtonia acutangula.	Rondeletia speciosa.
Ficus religiosa (pipal).	Jacaranda mimosifolia.
Brachychiton acerifolium.	Cestrum nocturnum. [chanana].
Bombax malabaricum (simal).	Tabernæmontana coronaria
Ficus indica (bor).	
Bassia latifolia (mowa).	
Butea frondosa (chichra).	
Aleurites moluccana (bahera).	

The following trees and shrubs which in previous years have been slightly affected have been killed or very seriously damaged :—

TREES.	SHRUBS.
Melia indica (neem).	Heliotropium (English).
Aegle Marmelos (bil)	Acalypha of sorts.
Ficus elastica (rubber).	Clerodendron infortunatum.
Sterculia alata.	" odoratum.
Inga dulcis.	Coleas of sorts.
	Hibiscus igora.
	Gmelina parviflora.
	Iresine of sorts.
	Allamanda of sorts.

The following have been badly damaged, but will eventually recover :—

TREES.	SHRUBS.
Saraca indica.	Dracæna terminalia.
Bursera serrata.	Plumaria of sorts.
Kigelia pinnata.	Plumbago capensis.
Dillenia indica.	Cestrum nocturnum.
Croton longifolia.	Bauhinia vahlii.
Ficus roxburghii.	Bougainvillea of sorts.
Pongamia glabra.	Bauhinia alba.
Ficus glomerata (gular).	Hibiscus of sorts.
Albizzia procera (safed siris).	Tabernæmontana dichotoma.
Cassia fistula (amaltas).	Jasminum grandiflora.
Tecoma mollis.	Poinsettia pulcherrima.

TREES.	SHRUBS.
Pterospermum acerifolium.	*Dodonaea viscosa.*
	Duranta of sorts.
	Hamelia patens.

The following trees and *shrubs were unaffected* by the frost :—

TREES.	SHRUBS.
Pistacia integerrima (rhus).	Lagerstroemia rosea.
Cedrela toona.	*Gardenia* of sorts.
Brachychiton populum.	Buxus nepalensis.
Eucalyptus of sorts.	Rhamnus utilis.
Grevillea robusta.	Myrtus communis.
Ficus retusa.	Ligustrum lucidum.
Millingtonia hortensis (bakain).	Magnolia grandiflora.
Putranjiva *roxburghii* (patazun).	Sophora secundiflora.
Sterospermum suaveolens.	Callistemon of sorts.
Platanus orientalis (chinar).	Enenymus japonicus.
Terminalia *of sorts.*	Flacourtia.
Camphora *officinalis* (kafur).	N*erium of sorts.*
Pinus longifolia (cheel).	Jasminum *humili* (*chambeli*).
Cupressus of sorts (saru).	
Juniperus prostrata.	
Thuja of sorts.	
Ceratonia siliqua.	

FIRE PROTECTION IN THE MANDUI RANGE, SURAT DISTRICT.

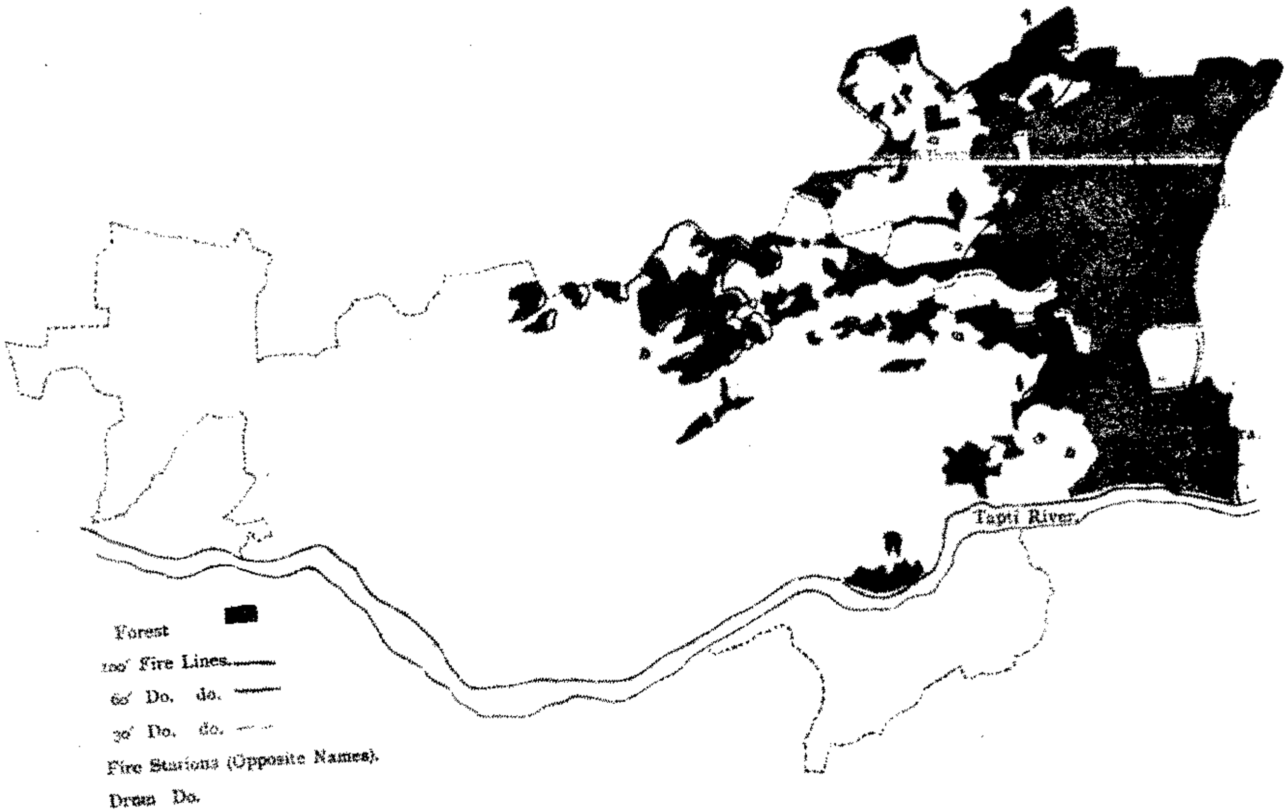
BY E. M. HODGSON, I.F.S.

At the request of the Honorary Editor, the following account of fire protection in the Mandui Range has been written, and will, it is hoped, prove of some interest, and possibly even of use also.

To begin with, there is nothing original in the scheme of fire protection which has been successfully applied to the Mandui forests, which is an undisguised copy of a system already inaugurated in the Panch Mahals by that energetic Forest Officer Mr. W. A. Wallinger. As was to be expected, however, certain details of the Panch-Mahals scheme were unsuitable to Mandui, while

MANDUI TALUKA

Scale 1" = 2 miles



the different circumstances of the latter place made it necessary to introduce new rules inapplicable, perhaps, to the Panch-Mahals.

The forests of Mandui are situated in the north-east corner of the division and are 41,847 acres in extent. The ground is hilly, the highest elevation being 929 feet. The forests are chiefly mixed teak and *raiwal*,* but pure teak, as well as pure *raiwal*, is

FIG. 1.—THE 30-FEET CUT LINE SEPARATING THE FOREST FROM VILLAGE LANDS.

found in some of the smaller western forests. Owing to drought the blanks, which support grass and reeds, have of late years become larger, and the forest, therefore, even more inflammable than formerly. Special measures, consequently, are a necessity.

The present system was started in the year 1898. In order to facilitate its description a map of the fire-lines, fire-stations, and drum-stations is given.

Early in October thousands of notices are posted up in the vernacular on trees at the entrance of roads or paths into the forest.

* Raiwal = everything except teak and bamboos.

These explain to the people exactly what acts, connected with fire, are prohibited by the Indian Forest Act and the rules thereunder, besides advising them to be on the safe side and not take fire-producing material into the forest at all. In addition, the subordinates are constantly warning the people in their villages, on the road and at bazaars, so that any one prosecuted pleading ignorance of the rules would be simply laughed at. Even contractors and their servants are made to sign a statement that they understand the rules in force. Notices too, showing the punishments inflicted for breach of rules, and which rules were infringed, are widely published.

The next measure is a very important one, *i.e.*, fire-tracing, mostly around the forest and along roads and foot-paths in the forest. This work has hitherto been started early in November, and finished, generally, by January 1st. Owing, however, to the people being all engaged in November in harvesting their crops the Collector has decided that fire-tracing in future is to be started on December 1st ; but if sufficient people come on the work then it will still be possible to have the lines ready by January 1st. Many of the labourers are old hands, and consequently most of them are well acquainted with fire-tracing work. Guide lines are cut first on each side and cross lines every 100 yards. When dry the grass, &c., is burnt on a calm day. Accidents are comparatively rare. In December, as soon as the grass is dry and fires become a real danger, eight fire-stations on high hills are started. These eight stations collectively command a view of the whole of the Mandui forests. From Bilia Hill all the other seven stations and from each of the other stations two or more stations can be seen with a telescope. Two men, generally local inhabitants, are in charge of each station.

They build themselves a hut to live in and a platform up a tree to watch from. Very often their families accompany them. In the hut a large iron drum is kept. One man keeps a look out for fires during the day from the platform, while the other patrols the neighbouring fire-lines, sweeps up fallen leaves, burns them, and listens for the sound of the drum. Both fire guards live in

E. M. Hodgson, Photo.

The Kaimoi Fire Station, Surat Forests.

the hut at night. If a fire occurs, the man on watch in the station rolls out his drum and beats it. The fire guard patrolling the lines climbs a tree, ascertains from the smoke where the fire has occurred, hastens to the scene, and tries to find the offender and put out the fire. The beat guards at the nearest guards' houses who happen to hear the drum sounded beat their drums to assemble the villagers.

To insure the presence of at least one fire guard on each hill the following checks are in force. On Mondays, Wednesdays, and Saturdays, at any time of the day, a beat guard goes and hangs up a certain ticket in the hut, bringing down another, and hanging it up in the guards' house the same day. On any day, but especially on Tuesdays, Thursdays, and Fridays, the Divisional Forest Officer, Sub-Divisional Forest Officer, Ranger, Sub-Ranger, and Round Guard pay visits and make certain entries in a book sealed to a post in the hut. Surprise visits are paid at night, too, occasionally.

At sunrise a white flag is flown high above the platform; at midday a red flag is placed under this: at sunset the white flag is removed. The Ranger has been supplied this season with a fairly powerful telescope with which he can check the flags on several, some times on all, the stations in one day.

By means of these fire stations and drums the following advantages accrue :—

(i) There is a general unwillingness to fire the forest, owing to increased fear of detection.

(ii) Fires are seen and signalled without delay.

(iii) Help is procured at once.

Probably by far the most important advantage is the prevention of delay. A fire in Mandui given a start of a few hours may go on for days in spite of all human effort. If, however, men are quickly brought on the scene it is always possible to prevent much injury.

In addition to these measures the subordinates and villagers receive every encouragement and inducement to help the Department. Those who serve faithfully as fire guards for a season, and require permanent appointments, are given preference when

vacancies occur. The conduct of all subordinates is carefully watched and noted with a view to giving promotion to the more deserving. The villagers, especially in years of want, are allowed every reasonable concession. Patels who render ready assistance are rewarded annually with a turban worth about Rs. 4. These turbans are highly prized, and some of those who failed to earn a *puggree* the first year they were given out succeeded in doing so the following year. If the villagers turn out very quickly when the fire alarm is sounded they are allowed a small wage.

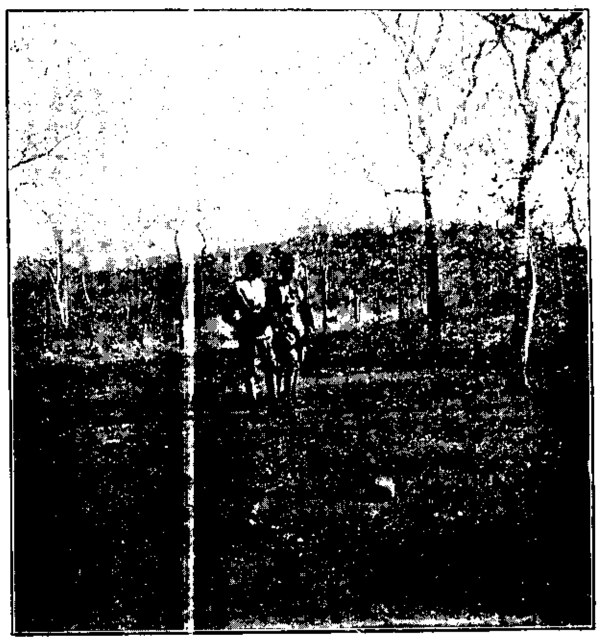


FIG. 2.—A 30-FEET CUT FIRE LINE SHOWING FIRE NOTICES ATTACHED TO A TREE AT ENTRANCE TO THE FOREST.

Inducements are given in the form of free-grants for cultivation and the right to cultivate a certain area, on payment, to a few persons called Forest Patels, in order to get them to live in *Ujed* or uninhabited villages, and help to protect the forest, more especially against fires. By the terms of the agreements these men have to relinquish their land, if called upon, within six months.

E. M. Hodgson, Photo.

The cut fire line between the forest and Karutha Inami village lands.

The following table is interesting, and shows the area burnt annually during the last eleven years, together with the cost of protection :—

YEAR.	Area attempted to be protected in acres.	Area burnt in acres.	Area actually protected in acres.	COST.
				Rs.
1894-95	41,846	16,374	25,472	1,314
1895-96	41,846	12,166	29,680	1,390
1896-97	41,846	4,100	37,746	1,233
1897-98	41,846	12,638	29,208	1,441
1898-99	41,846	7,766	34,080	1,332
1899-00	41,846	8,045	33,801	1,542
1900-01	41,846	1,964	39,882	2,286
1901-02	41,846	958	40,888	2,744
1902-03	41,846	2,541	39,305	2,841
1903-04	40,549	804	39,745	3,367
1904-05	40,549	*Nil.*	40,549	2,602

The cost varies somewhat according to the season. On an average, if arrangements are to be really effective, it will amount to Rs. 2,500 a year, or about 1 anna per acre.

Though the area burnt has, this season, been reduced to *nil*, the system is still capable of further improvement. Firstly, the cost of protection is rather high, even if the results appear satisfactory. This could be reduced by clearing the fire-lines of all trees and bushes. At present the outer 100-foot line, which separates the Mandui forests from the annual conflagrations in the neighbouring Baroda State forests, and a few of the others, mostly outer lines too, have been cut. But those on which trees are still growing become, quite early in the season, covered with fallen leaves, and need constant labour and expense to keep them clean and efficient. The time the beat guards and 16 fire guards can give to line-cleaning is not enough without the occasional help of extra coolies. It must be remembered, too, that cut lines, as can be seen in Mandui any way, are so much cleaner, and consequently more effective, that the present 100-foot inner lines could be reduced to 50 feet after being cut for the latter width. This matter rests with the Forest Department.

But there is one other point, and it is in the hands of Government. At present the forest villagers pay annas two per head for grazing for their cattle. If Government would be pleased to cancel this rule, and instead to allow absolutely free grazing in any forest village in which in the previous season there had been no fires, or on payment of Re. 1 per head if a fire had occurred, then, provided always the Forest Department does not relax its efforts, forest fires in Mandui would become a matter of past history.

Explanation of the illustrations.

Plate XVII—Shows the 100-foot cut line, over 20 miles long, separating British from Baroda State Forests. This line has never been crossed by fire.

Fig. 1—The 30-foot cut line separating the forest (high growth) from grass, bushes and *scattered trees in Ambapur Inami village.*

Fig. 2—The same fire line as No. 2 but showing notices hung up on a tree at the entrance of a road into forest. This road was also fire-traced, but as it had become covered with fallen leaves it would not appear different in a photo from the rest of the forest.

Plate XXXIX—Shows the Kalmoi Fire Station. The big drum is shown in the foreground in front of the hut.

Plate XL—Depicts the cut fire line between forest and Karutha Inami village.

THE FORMATION OF THE FOREST DEPARTMENT IN SIAM.

BY W. F. L. TOTTENHAM, O.U.S.E., I.F.S.

In 1895 the late Mr. Slade's services were lent to Siam to advise that Government on Forest matters, and the following is a short account of the very valuable services rendered by him to Siam in connection with the formation of the Forest Department in that country.

The greater part of 1896 was spent on tour, inspecting the more valuable forests, visiting the principal centres of the timber trade, enquiring into the systems of revenue collections, &c., &c., and a vast amount of information on all matters connected with Forestry in Siam was thus acquired.

On his return to Bangkok he submitted a report to the King in which were embodied certain proposals necessary for the better protection of the forests, among which was the formation of a Forest Department, which was at once sanctioned, and Mr. Slade appointed Chow-Krom. The services of several other trained officers were then obtained from the Government of India, and the training of Siamese lads at once commenced.

The principal trade being in teak, the areas producing that timber were first taken in hand, and Mr. Slade's Burma experience here proved of the greatest value. The greater part of the teak forests are situated in the Laos States (N. Siam) which border on the S. Shan States, Karenni and Indo-China.

Great trouble was experienced in getting the Laos Chiefs to relinquish all claims to hereditary ownership of the forests in their States, but Mr. Slade at last accomplished this, and the control of these forests was handed over to the Forest Department, each Chief receiving half of all royalties collected in the forests of his State instead of the whole, as hitherto. The issue by the Chiefs of irregular permits to work teak was prohibited, but as a very great concession, to avoid hardship, permits issued before a certain date were exchanged for leases ratified by His Majesty, and work thus legalised.

One of the first steps taken by Mr. Slade towards the introduction of systematic forestry into Siam was the drafting of a Forest Act. The difficulties attending legislation under extraterritoriality however proved insurmountable inasmuch as several years' constant work would have been required to pass that Act into law while there were in existence many very pressing abuses which required immediate suppression. Legislation was at last effected by the issue of a series of Royal Decrees, and by this very laborious means a somewhat poor substitute for a Forest Act was gradually built up.

One of the first of these decrees prohibited the girdling or felling of undersized teak trees, and thus an end was put to an enormous trade in poles and saplings which had not only endangered the future of a very considerable number of the most

valuable teak forests but threatened the extermination of teak over large areas.

Decrees were issued later (i) prohibiting the girdling or felling of teak except under a lease ratified by His Majesty; (ii) dealing with the defacing of marks and supermarking; (iii) regulating the use of private hammers; (iv) prohibiting the removal of timber without property marks, &c., &c., and thus the most urgent measures for a proper protection of the forests and control of the workings were established.

In the meantime the old form of lease proving unsuitable and inadequate, a new form was drawn up under which the minimum girth at which trees could be girdled was considerably raised and provision made for the imposition of fines for destruction of timber, &c., &c. After innumerable lengthy negotiations Mr. Slade got the principal lessees to agree to exchange their leases under the old form to the new form, and their example was largely followed by the smaller lessees.

Mr. Slade having organised the various establishments of the Forest Department and split up the country into divisions, a systematic survey and examination of the forests was commenced in 1897-98, and by the end of 1900 sufficient data had been collected to allow of a decision as to the future policy to be adopted.

This examination confirmed what had been feared, namely, that the forests were being worked beyond their possibilities, and as leases fell in many large areas were in consequence closed and workings in areas which were reopened confined to the extraction of dead teak only, a condition of the renewed lease providing for girdling by a Forest Officer only if the possibilities of the forest were not being worked up to.

It must not be supposed however that Mr. Slade's attention was only confined to teak; on the contrary, every effort was made to encourage the trade in "other woods," and considering the inadequacy of the establishment these efforts were attended with very considerable success.

The training of young Siamese lads in Forestry with a view to their ultimately being placed in responsible positions although

attended with very many disappointments was persevered in and took up much very valuable time.

The following figures amply suffice to prove that the collection of revenue had not been neglected and that the new systems introduced by Mr. Slade were successful :—

	Rev.	Exp.	Surplus.
	Rs.	Rs.	Rs.
1897-98	6,36,000	3,11,000	3,25,000
1900-01	13,88,000	3,81,000	10,07,000

To fully appreciate what this increase means, however, it must be remembered that more than half of the area of forests originally worked had been closed, the minimum girth raised, and a trade which produced a very considerable revenue crushed (*i. e.*, that in teak poles).

To effect the above in this very short space of time would under the most favourable circumstances be extremely creditable, but when the innumerable difficulties which beset Mr. Slade at every turn are taken into consideration it may be understood that it could only have been accomplished by the most extraordinary tact and perseverance as well as the devotion of his whole energies to what must so often have seemed not only an impossible but a thankless task.

That His Majesty to some extent appreciated his efforts may be gathered from the fact that he was graciously pleased to create him a Companion of the III class of the Order of the White Elephant of Siam, the highest honour he could confer.

EXTRACTS FROM OFFICIAL PAPERS.

THE PROMOTION OF ROADSIDE ARBORICULTURE.

We have already drawn attention in these pages to the great importance of planting avenues along the roads in this country and to the apathy and neglect which this work meets with in many districts. Until within quite recent years the great operations of the earlier administrations which gave to the main arteries of the country and most of the smaller ones the fine avenues now in existence had, doubtless in some measure due to the increased facilities of travel following the introduction of railways, fallen into almost complete abeyance. Blanks in the great avenues due to the overthrowing of trees during severe tropical storms or to their natural decay were not filled up, and the planting up of the many new lines of communication opened out was entirely neglected.

We last year alluded to the fact that the Government of India had addressed Local Governments on this matter. A Resolution has now been issued by the Department of Revenue and Agriculture dealing with measures for the promotion of roadside arboriculture. We welcome it alike for the far-sighted statesman-like policy it gives evidence of and for the incalculable benefits to posterity it is likely to result in.

The Resolution commences by stating that the Government of India, having had under consideration the subject of the maintenance of avenues of trees along roadsides in India, communicated to the Local Governments and Administrations in March 1904 some observations which may be repeated here. The question,

they said, is one of real importance, because of the welcome shade afforded thereby to wayfarers, the substantial addition to the beauties of the landscape, and the mitigation of the discomforts of long journeys by road. The practice of planting avenues of this description was in earlier days as much a feature of British administration as the construction of the roads themselves, and some of the older avenues on the main roads of India still supply the most agreeable of memorials to the taste and prevision of their founders. The practice has nowhere died out, and it is still fairly widely though intermittently and unmethodically, pursued. In recent years, however, great havoc has been caused in some tracts by the mutilation and cutting down of timber in times of famine, and observation tends to show that these ravages have been only partially repaired In other parts of the country the importance of the matter appears to have been imperfectly kept in view, and from want of a sustained policy, money and effort have been wasted; and in many places avenues, formerly in existence, have been allowed to disappear or to become disfigured by unsightly blanks.

The Government of India have now ascertained from the Local Governments the arrangements at present in force in various provinces for the maintenance of roadside avenues. The opportunity is, therefore, taken to present a brief review of those systems now under contemplation.

In Madras all expenditure is from the local funds. The total length of roads in charge of the local boards is 27,619 miles, of which 16,566 have been provided with avenues, the total number of trees being three millions. During the past ten years 177 miles of avenue were planted, the annual expenditure being Rs. 96,000 and the income Rs. 117,000.

In Bombay no detailed statistics are available, but as a rule on the existing provincial roads good avenues exist where the ground is suitable. The want of funds checks the extension of tree-planting.

In the Central Provinces and Berar 3,000 miles are still devoid of trees, out of 4,200 miles. The Public Works expenditure

on avenues is to be gradually raised from Rs. 46,000 to Rs. 90,000 annually, while the District Councils are to spend Rs. 25,000.

In Bengal 2,600 miles have been planted during the past ten years by the District Engineering staffs. The average expenditure is Rs. 52,973 and the average income only Rs. 13,395. A comprehensive programme is to be drawn up on the lines adopted in the Central Provinces, and the Local Governments will decide the minimum expenditure by each District Board.

In the United Provinces during the last ten years about 1,300 miles have been added to the length planted, which now amounts to some 8,000 miles; but there are still some 20,000 miles of road of all kinds without avenues. The average expenditure was Rs. 81,000, and the average income Rs. 77,000, so that the net expenditure averaged only Rs. 4,000 per annum for the ten years; and for the last five years there was actually an average surplus of Rs. 6,000. Working plans have been prepared for most districts. Arrangements are being made to appoint and train supervisors, and a new manual of arboriculture is ready for issue.*

In the Punjab the length of roads suitable for avenues, apart from those managed by the Canal Department, is 15,000 miles, of which 8,000 miles are fully planted. During the last ten years the addition made to the length of avenue has been 1,200 miles. The average annual expenditure has been Rs. 2,63,000 and the average income Rs. 1,98,000 (but these figures include the results for groves and plantations as well as avenues). For canal roads, the corresponding figures are: Total length of road or canal, 8,000 miles; planted, 4,100 miles; average expenditure, Rs. 1,07,000; average income. Rs. 85,000. The Province has a useful manual of arboriculture, and detailed instructions have recently been issued for systematising operations for the preparation of working plans with maps, and for the training of supervisors.

In the North-West Frontier Province good progress has been made, the annual expenditure being Rs. 42,000 and the income Rs. 9,000. The Chief Commissioner hopes to increase the

* This will be reviewed in the September number.—HON. ED.

expenditure and to provide training for the staff, together with working plans.

In Baluchistan, owing to the arid climate and indifference of the people, small progress is reported. The revenue assigners and persons in receipt of allowances are being called upon to plant trees, while honours and rewards are to be granted to those who distinguish themselves in this useful work.

In Ajmer-Merwara an improved system was introduced a few years ago with encouraging results.

The Government of India, in reviewing these reports, says that the first, and in some respects gravest, difficulty in arranging for the extension of operations is the provision of funds. It is suggested that the net and not gross expenditure should be looked at, and that it is material to observe that the grant recently made to District Boards from general revenues will enable them to make better provision for all these duties, including arboriculture. Various useful suggestions are then made as to the preparation of working plans, the planting of trees, supervision, etc. The Resolution contains the following paragraph :—

"It is essential that as far as possible the sympathies of the neighbouring population should be enlisted in the preservation of the roadside trees. In the case of fruit trees, the produce of which is of little value, cultivators of adjoining fields should be allowed to take the fruit on the condition that they protect the trees from serious damage ; and when a fodder famine is prevalent judicious arrangements should be made to utilise the edible leaves of trees along the roadsides as fodder for cattle at reasonably cheap rates. This does not mean that the trees themselves should be heedlessly mutilated or cut down, but that the temporary sacrifice of sylvan amenity may be gladly accepted in the interest of saving valuable animal life. The practice of lopping or otherwise injuring a beautiful avenue when preparations are made for the reception of a high Government official is particularly deprecated. As regards investigating the progress made in roadside arboriculture, the Government of India are content to leave the Local Administrations to prescribe such arrangements as they think best."

The Resolution concludes :—

" The Governor-General in Council believes that if regard is paid to the suggestions above put forward, and if due advantage is taken of the recent additions made to the resources of District Boards, the planting and maintenance of roadside avenues in this country will be placed on a far more satisfactory and systematic footing than heretofore. He trusts that in consequence of the renewed attention which may now be expected to be devoted to the subject the ravages caused by neglect and famine will be gradually but surely repaired and that the advantages, which the *present generation has reaped from the energy and foresight of* its predecessors, will be continued in even fuller measure to posterity."

REPORT ON THE WORKING OF THE CASUARINA PLANTATIONS IN THE NELLORE DISTRICT SINCE 1899-1900.*

BY E. R. MURRAY, DISTRICT FOREST OFFICER, NELLORE.

The accompanying statement shows the blocks which have been worked since the introduction of the working plan in the year 1899-1900:—

Year.	Number of compartment worked. Dugarazpatnam	Kottapatnam.	Tamminipatnam.	Varini.	Quantity of wood brought to depôt when departmental operations were carried on.	Revenue realised	Expenditure incurred.	Net profit.	Net profit *per* ton.	Net profit *per* acre.	Remarks.
					T. W.	R. a. p.	R. a. p.	R.	R. a. p.	R. a. p.	
1899-1900 ...	5	3	4	3	7,858 05	44,507 0 9	11,985 0 0	32,522	4 2 2	81 0 0	V of Dugarazpatnam, III of Kottapatnam, IV of Tamminipatnam, and III of Varini (397 acres) were worked departmentally during this year.
1900-1901	3	4	6	2	4,373 35	17,817 0 0	6,747 0 0	11,070	[illegible] 8 6	84 8 0	Only compartment IV of Kottapatnam [illegible] acres was worked departmentally during this year.
1901-1902 ...	4	8	5	4	2,105 15	9,5[illegible]6 12 6	2,295 13 4	7,330	3 7 3	77 2 6	Only compartment IV of Dugarazpatnam (95 acres) was worked departmentally during this year.
1902-1903 ...	1	10	1	1	...	10,4[illegible]7 0 0	240 0 0	10,227	2 9 5	61 13 8	Area cut, 327 acres. Quantity of wood removed, 7,811 tons.
1903-1904 ...	2	2	10	10	...	31,7[illegible]5 0 0	495 0 0	31,280	...	87 2 1	Number of acres cut, 359. Number of tons cut, not known.
1904-1905 ...	7	7	7	9	...	38,0[illegible] 0 0	...	...	...	...	*Area sold, 354 acres.*

2. In the opening year of the operations, all four blocks, aggregating in area 397 acres, were worked departmentally, 7,858 tons of wood having been trammed to the various depôts on the canal. This wood when sold realised Rs. 44,507, and as the

*Department of Land Revenue, Madras, Forest Branch, No. 2. Superintendent, Government Press, Madras, 1905.

expenditure on working it out was Rs. 11,985, exclusive of establishment charges and cost of laying the tram lines, etc., the net profit was Rs. 32,527, giving an all-round rate of Rs. 81 per acre.

In the following year, only one block of 131 acres was worked departmentally, the growth on the other three being sold as it stood. The result of the departmental operations was 4,373 tons of wood brought to depôt, an expenditure of Rs. 6,747 having been incurred thereon, sold for Rs. 17,817, giving a net profit of Rs. 11,070 and an average all-round rate per acre of Rs. 85. The sale of the standing growth brought in Rs. 9,485, or a net revenue of Rs. 36 per acre, the area sold being 262 acres. In the year 1901-02, one block was again worked departmentally, 2,105 tons of wood having been brought to depôt at a cost of Rs. 2,296. The wood sold for Rs. 9,525, giving a net profit of Rs. 7,330, or Rs. 77 per acre, the area of the block being 95 acres.

The remaining three blocks, aggregating in area 278 acres, realised Rs. 15,275, or Rs. 54 per acre.

3. Since the year 1902 all the blocks have been sold as they stood; in the first year Rs. 20,467 having been realised, in the next Rs. 31,773, and in the third, the current year, Rs. 38,000, giving net profits per acre of Rs. 62, Rs. 87, and Rs. 107, respectively. The somewhat low rate per acre realised in 1902-03 is partly attributable to the exceptionally poor growth in one of the compartments (No. 1 of Tamminipatnam) offered for sale, but with this exception the prices realised during the later years are, taking them all round, far in advance of those previously obtained, and, I believe, are attributable, in a large measure, to the satisfactory working of the tramway as compared with former years.

The larger profits can hardly be said to be due to the exceptionally large or old trees sold in those years as the following figures will show :—

The ages of the several blocks sold between the years 1900 to 1904 were more or less uniform, the estimated outturn, after an actual enumeration of the trees in each block, being as follows :—

Three blocks sold in 1900-1901.—Estimated outturn 3,500 tons ; price realised, Rs. 9,485.

Three blocks sold in 1901-1902.—Estimated outturn, 7,000 tons; price realised, Rs. 15,275.

Four blocks sold in 1902-1903.—Estimated outturn, 6,000 tons; price realised, Rs. 20,467.

Four blocks sold in 1903-1904.—Estimated outturn, 9,000 tons; price realised, Rs. 31,775.

Four blocks sold in the current year.—Estimated outturn, 7,400 tons; price realised, Rs. 38,000.

Early this year it was said that there was a brisk demand in Madras for casuarina wood, but of this I cannot speak with certainty. It is probable, however, that the actual demand was no greater than in past years.

4. Mr. Popert on the last page of his "Note on Casuarina Planting" estimates the cost of a fully established plantation at Rs. 33 per acre, but the results obtained here during the past few years show that this estimate can be greatly reduced. It is not possible to give figures relating to more than nine blocks, five of which were planted up in 1900-01, and the remainder in the following year, and which are, therefore, fully established plantations under the prescriptions of the working plan. The expenditure on the first five blocks gives an average cost of Rs. 31 per acre, a figure which is much the same as that given by Mr. Popert; but the next four blocks show only Rs. 20 as the cost incurred on their establishment, and there is reason to believe that even this can be further reduced.

The details of the several operations which make up the aggregate of Rs. 20 per acre are—

	Rs.	a.	p.
Preparing the land for planting, digging wells, and planting out (including nursery charges)	2	12	0
First year watering charges	11	8	0
Second year watering charges	5	0	0
Third year watering charges	0	12	0
Total ...	20	0	0

The average rainfall for the years 1870 to 1899 at the two recording stations on the coast (Dugarazpatnam and

Krishnapatnam) was 36·16 and 37·21 inches respectively. At the same stations, during the three years ending 1903 the average was 38·32 and 41 inches. It may therefore be said that the years in which Rs. 20 per acre were spent were years of normal rainfall.

The rainfall having been normal, water was not more accessible, nor can it be said to have been less required during those years. Earlier planting has, of course, produced better results, but the true answer to the question is, I believe, a much closer control, than formerly, over the expenditure.

5. The estimated yield, as found by Mr. Popert, of a plantation over ten years old, *viz.*, 49 tons per acre, seems too high. The results of the working of the casuarina plantations in this district during the past four years give an average yield per acre of only 25 tons (the average age of the trees in the several blocks felled over being very much more than ten years), and this, I think, will be found to be the more accurate figure.

Accepting Rs. 3-8-0 as the average selling rate per ton, the figures would work out as follows :—

	Rs. a. p.	Rs. a. p.
Revenue		87 8 0
Cost of planting per acre	20 0 0	
Interest at 5 per cent for 10 years	10 0 0	
Establishment charges at 5 per cent for 10 years ...	10 0 0	
		40 0 0
Total Net Revenue ...		47 8 0

As regards value of tramway plant, Rs. 20,000 has, as nearly as possible, been spent on it up to date. The charge per annum may therefore be put down at—

	Rs.
First year—	
Interest at 3 per cent on Rs. 20,000	600
Depreciation at 4 per cent	800
	1,400

	Rs.
Second year—	
Interest at 3 per cent on Rs. 19,200	576
Depreciation at 4 per cent	768
	1,344
Third year—	
Interest at 3 per cent on Rs. 18,432	552
Depreciation at 4 per cent	736
	1,288
Fourth year—	
Interest at 3 per cent on Rs. 17,716	531
Depreciation at 4 per cent	708
	1,239
Fifth year—	
Interest at 3 per cent on Rs. 17,008	510
Depreciation at 4 per cent	680
	1,190
Sixth year—	
Interest at 3 per cent on Rs. 16,328	489
Depreciation at 4 per cent	652
	1,141
Seventh year—	
Interest at 3 per cent on Rs. 15,676	470
Depreciation at 4 per cent	628
	1,098
Eighth year—	
Interest at 3 per cent on Rs. 15,050	450
Depreciation at 4 per cent	600
	1,050

	Rs.
Ninth year—	
Interest at 3 per cent on Rs. 14,150	433
Depreciation at 4 per cent	576
	1,009
Tenth year—	
Interest at 3 per cent on Rs. 13,884	416
Depreciation at 4 per cent	555
	971

Total interest and depreciation for ten years is Rs. 11,725, or per annum Rs. 1,172.

Assuming cost of tramway, first rotation, to be Rs. 11,725, the cost per acre is $\frac{11,725}{3,712}$ = Rs. 3-2-6 nearly. The second and subsequent rotations would cost much less, but there would be constant repairs, and something must be allowed for replacing machinery. The cost under this head may therefore be fairly placed at Rs. 3-8-0 per acre. The total cost per acre inclusive of all charges is therefore Rs. 43-3-0, giving a net revenue of Rs. 44 per acre per annum.

SCIENTIFIC PAPERS.

SOME INDIAN FOREST FUNGI.

BY E. J. BUTLER, M.B., F.L.S.

CRYPTOGAMIC BOTANIST TO THE GOVERNMENT OF INDIA.

To one interested in the lowly mushrooms and moulds India, at first, often comes as a disappointment. Before experience one pictures all tropical countries as teeming with rare and beautiful forms of plant life, and there is no hint that the fungi are to be, even partially, excluded from the scene. The reality is in many cases a cultivated plain or a paddy swamp extending as far as the eye can reach. Of fungi there are few, and these often familiar crop pests. There are no moist woodlands as in Europe. The trees are mango groves, or palms clustered around the villages, or avenues of shade-trees bordering the roads. Even the jungle is too often dry scrub, the last place in which fungi could flourish.

The odour of decay is absent, fallen leaves are scarce, decaying branches—most loved of fungi—are almost unknown. For in India life is too hard to allow of anything that burns being left to waste. There are, too, few old fences, or grassy slopes moist from the shade of trees, or any, except rarely, of those other favoured spots to which the mycologist must look to gather his harvest. The reasons for this are simple. The population is very dense, with consequently a close cultivation of the land. Added to this is, in the parts to which I refer, a climate too dry for the greater part of the year and often too heavily flooded in the rains to permit of that gradual return to the soil of organic matter in which the fungi find their most favourable conditions of development. I can hardly imagine anything more unsuitable looked at from this point of view than the plains of Northern India from the Punjab to Behar or the bare uplands of the Deccan.

But there are great areas in the continent, often away from the beaten track, in which all these conditions are changed. The region at the base of the Himalaya and the slopes of the hills themselves as high as the forest vegetation goes, much of South India, both the moister mountainous parts and the tracts along the coast, all of the Ghats, much of Lower Bengal and Assam are rich in fungi. In the forests fo these regions, amongst which are some of the most important in India, there is a vast amount of material awaiting collection, and there are few in India with such opportunities of helping a much-neglected branch of science as the officers of the Forest Department in these places.

In the following notes reference is made to parasitic fungi only. These, though independent of decaying plant-food, getting their nutriment as they do from the living tissues, find in the forest conditions of moisture and shade most favourable to their development. So far as my experience goes the parasitic forest fungi enormously exceed those of the open country in number, though their economic importance is less evident.

That the study of fungi is a necessary branch of forest science need scarcely be remarked. Their importance in forest economy will be evident to any one at all acquainted with the

work of German mycologists. The results obtained in that country are largely applicable to the rest of Europe. In India, however, we can draw only to a slight extent on experience elsewhere, and there is, as yet, little to offer in its place. Even where the parasites are identical the trees on which they live are usually distinct, and it is at least possible that the mode of action differs with the different hosts. In the well-known conifer parasite, *Fomes annosus*, the extension by *rhizomorphs* is a characteristic feature of its attacks on the deodar in the Himalaya, while these organs have not been described for the same fungus in Europe, either because they do not exist or, as Prof. Mayr believes, because they have escaped attention. In any case they can hardly be as well marked as in India. But it is probable that the majority of our parasites are entirely different to those of Europe and America, and the fact that a larger number of new forms have not been brought to light is only an evidence of our want of knowledge of the subject.

I have received several specimen of parasitic fungi on forest trees and shrubs within the past two or three years, mostly through the kindness of Forest Officers. Some of these have been the cause of very considerable damage, as in the cases of *Fomes annosus* on deodar *Fomes Pappianus* on babul, *Trametes Pini* on *Pinus excelsa*, the *Trichosporium* on casuarina, &c. Others, such as the rust fungi of conifers and Ephedra and of the barberries, are of less account. But even the latter are often of great interest from their indirect influence on the diseases of cultivated crops or important industries such as tea and coffee planting. For instance rust on cereals has often been attributed to the fungi of the Himalayan forests, and there is no doubt that this view has influenced considerably those in India who have given thought to these diseases. The *Rosellinias*, fungi which arise in the decaying stumps of many trees, have proved a serious trouble in tea and coffee cultivation, giving rise to constantly expanding patches of what is known as "stump rot" in many estates, within which every bush is destroyed. If taken early they can be checked, and their prevention by a proper treatment of the tree stumps seems not beyond

the bounds of possibility. The forester who can devise a satisfactory and cheap method of destroying stumps after felling by burning or blasting, or who can show how to preserve a stump from rotting in the mass, will confer a real benefit on planters in India. From a disease of this nature, combined with another parasitic fungus, the cultivation of pepper on a large scale in Mysore, which is otherwise full of promise, has been prevented. Again, there is the remarkable group of host-changing fungi—the *Uredineæ* or rusts—about whose life-history the late Dr. Barclay has told us so much. Large numbers of these are known in India, in one stage only, and the other stages are probably passed on different plants. Some of these in the forests may be found to have a direct bearing on crop diseases. And leaving out of consideration altogether the economic aspect, the forests are full of interesting forms, capable of throwing light on obscure questions as the rhododendron rusts perhaps do in one direction, or of affording valuable materials for study. Our collections of Indian fungi are as yet very meagre. We do not even know the identity of the species which produce the phosphorescence noticeable in the forests in some places, nor completely the identity of the edible forms of India. If, then, Forest Officers whose locality offers them the opportunity can be induced to collect and study the fungi of their districts, both those injurious to trees and those otherwise of interest, a great advance in our knowledge of a little-known subject will almost certainly be the result.

TRICHOSPORIUM DISEASE OF CASUARINA.

The Casuarina plantations on the sand dunes of the East Coast are subject to several diseases. Some of these are due to insect pests and have been described in this Journal by Mr. E. P. Stebbing (*Indian Forester*, September 1903). One, however, which I saw in the Chatrapur plantations with Mr. C. Fischer, I. F. S., in August 1904, is of a fungal character, and being one of those slow and steadily progressing diseases which may eventually become a serious matter, requires more than passing notice.

Attention appears to have been first called to the fungus attack during Mr. Stebbing's visit in July 1903. Amongst the dead trees, of which there were a number in the plantation, some were found with the bark raised up into great blisters, and eventually ruptured by the formation of a black powdery substance consisting of myriads of spores of a fungus. Enough of this powder was easily collected to fill a small box. It appeared on very few trees, however, and the idea that it was connected with the disease was for a time abandoned by Mr. Fischer. When we walked through the plantation only two or three instances were found, and the majority of the dead trees, of which several hundreds were seen, had perfectly normal bark with no sign of the presence of any parasite.

The trees died out in patches, of which two or three large and several smaller ones occur within the Agusti Nowgam plantation. No reason could be given why some parts of this plantation were failing, while the rest flourished. But the examination of specimens collected during my visit and of others subsequently sent sufficiently explained the matter. A parasitic fungus was found within the central wood, which there can be little doubt is the cause of the disease. It is, curiously enough, apparently identical with that first found in the bark, some minor differences in structure and measurements being probably due to the different conditions of life passed buried in the wood, and that passed in the cambium where access to the outside world becomes possible by the rupture of the bark. Why it should sometimes remain internal and sometimes break out on the surface is not clear.

In the earlier stages the trees look sound enough, even when the collar is exposed, except that many of the twigs are dead and clusters of withered needles remain attached to them, the whole appearance suggesting water-logging or drought. The extension of the dead patch from which the specimens were taken in a centrifugal manner up a sharp slope of the sand, which is here very deep and the healthy state of the adjoining trees put these possibilities, however, out of the question.

The internal fungus was found in the specimens examined in a part or the whole of the wood of the collar, extending six or eight inches below the surface of the soil and a few inches above. It occupies the centre of the wood, reaching in one or two places to the vicinity of the cortex, but elsewhere separated from the exterior by an inch or more of sound tissue. It is not visible to the naked eye, but in some cases is accompanied by a discolouration of the wood, visible on section. In some of the specimens

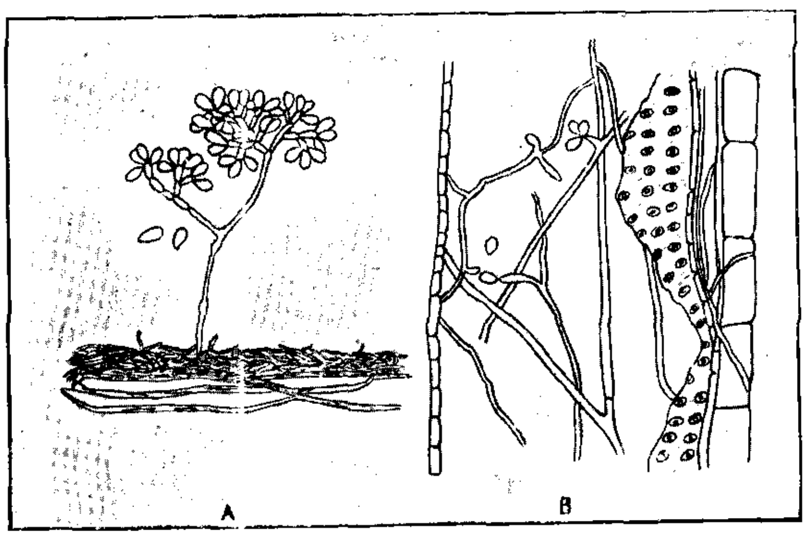


FIG. 1.—TRICHOSPORIUM ON CASUARINA; *a*, BARK FORM; *b*, INTERNAL FORM WITHIN A WOOD VESSEL.

it was impossible to determine if the fungus were present or not without microscopical examination. The wood of many of the lateral roots is also discoloured, and where they enter the tap root their passage through the exterior tissues is sometimes distinctly visible as dark streaks. These lateral roots as well as the diseased patch of collar wood contain fungus hyphæ, while the rest of the tissues are quite free from them.

The hyphæ lie within the vessels and cells, boring their way through any intervening cell-walls. Both brown and colourless ones, belonging to the same mycelium, occur, in some parts the brown predominating, while in others only colourless can be found. In the smaller roots brown hyphæ are rare. On lateral branches from the main filaments spores are borne at or near the apex in small clusters. They are at first more or less spherical and colourless, but later become oval and brown, falling easily and lying within the vessels. Their utility in this position can be but slight, for none were found in the smaller roots and decay of the collar sufficient to liberate the spores would probably take some years. Unless the fungus also forms spores in the soil, its propagation is likely, so far as the subterranean form of attack is concerned, to be mainly vegetative by means of a soil mycelium extending from root to root through the ground. The centrifugal progress of the disease from a few centres lends support to this view.

The destruction of the wood is not considerable. All the contents of the cells invaded by the hyphae are destroyed and a brown residue fills those which have had living contents, such as the parenchyma, giving rise to the discoloured appearance of the diseased tissue sometimes observed. Lignified tissues are but slightly attacked, and there is no change apparent in the walls of the fibres until a late stage. The effect of the fungus on the tree is greater than would appear warranted by the mere destruction of the living contents of the cells, and the physical result of blocking of the vessels with hyphæ. It is probable that the death of the trees is largely due to ferment production, or the formation of some poisonous substance thrown into the sap, as happens in so many cases of the sort. In the sugarcane red-rot for example the fungus *Colletotrichum falcatum* is often confined to one or a few internodes near the base of the cane, but the total crystallisable sugar is greatly diminished by the action of a sugar-inverting ferment, formed by the fungus and acting on the sugar-containing sap. The greater part of the damage is apparently due to this ferment.

The bark-rupturing fungus, first observed, produces far more striking effects.

The bark is lifted from the cambium along the trunk into great blisters *by the formation here of a layer of densely woven hyphæ*, which produce spores in such abundance that the black powder composed of them is sometimes a quarter of an inch in depth. Later on these blisters rupture, raising the bark in loose sheets

FIG. 2.—CASUARINA STEM ATTACKED BY TRICHOSPORIUM.

and exposing the spores. The tissues under the spore-producing layer are invaded everywhere by hyphæ, which are colourless in the outer cells and sometimes brown deeper in. Microscopically no difference can be observed in the mycelium of this from that above described, except that the portion from which the sporophores arise is invariably colourless. The spores in this case are also rather larger and their colour deeper brown. They are borne

on hyphæ of variable length and often branched, each branch bearing a cluster of spores near its tip on the main axis or on short thick branches of the secondary or tertiary order. Branched sporophores of this type were not observed in the internal form, but the latter was much more difficult of examination and the spores were very rarely found fixed *in situ*.

In the absence or rarity of the external mode of fructification and from the nature of the diseased patches, it is probable that the fungus extends through the upper layers of the soil from root to root. Hence the only suggestion for treatment which can be made at present is to remove as early as possible all diseased trees to prevent the bark destroying form, which appears to be of late appearance, from developing. The collar and main roots should also be removed in trees near the margin of the diseased patches as far as possible. Trenching might prove effective in checking progress, but further observations and trials are necessary before the efficacy of this can be established. After clearing it will be unsafe to replant for some two years or so as the fungus is likely to persist for some time in the smaller roots which are left.

This fungus possesses many points of resemblance in the bark form to another tree-destroying fungus found by Mr. Massee of Kew on mulberry trees sent him from Changa Manga, in the Punjab. The mulberry fungus which Mr. Massee named *Trichosporium aterrimum* is also made manifest by a rupture of the bark from the cambium in which its spores are formed. The minute structure, however, differs in some respects, particularly the size of the hyphæ and the mode of origin of the spores, though the specimen which I examined from the Forest School Museum was not entirely satisfactory for determining the minute characters of the fungus. In any case the name *Trichosporium aterrimum* cannot stand since it has already been used by Saccardo for a species of Corda's (*Sylloge fungorum IV*, p. 289). I have named the Casuarina fungus *Trichosporium vesiculosum* n. sp. and the diagnosis is as follows :—

Trichosporium vesiculosum n. sp. - Hyphae brown or colourless within the tissues or forming colourless cushions in the cambium ;

fertile hyphæ colourless, $1\frac{1}{2}$ to 2 micro-millimeters in diameter, bearing clusters of spores inserted at or near the tip on the thickened end of the main axis or of secondary and tertiary branches, several on each branch; spores sessile, ovoid, brown, in the mass black, forming a dense layer in the cambium fewer in the tissues, $5—8 \times 4\frac{1}{2}$ - 6 for the external and $6 \times 4\frac{1}{2}$ micro-millimeters in diameter for the internal.

Parasitic on *Casuarina equisetifolia*, which it kills—Chatrapur, Ganjam, India.

Allied to *Trichosporium aterrimum*—Massee not Saccardo.

ORIGINAL ARTICLES.

THE EFFECTS OF THE GREAT FROSTS OF 1905 ON THE FORESTS OF NORTHERN INDIA.

IV.—THE EFFECT OF THE *UNPRECEDENTED* COLD WEATHER ON THE FOREST VEGETATION IN MONTGOMERY DISTRICT.

BY GHULAM MOHAMAD

EXTRA ASSISTANT CONSERVATOR OF FORESTS.

(1) As the climate of the Montgomery district is dry and the soil is arid, the severe cold and low temperature of the past winter has very much affected the forest growth.

(2) The usual time of opening of the new buds is the spring season, but owing to the severity of last cold weather the new shoots were a month late. As the trees did not produce new shoots at the proper time, the annual growth of the forest crop has been checked. Moreover, the trees have yielded no seed, hence natural reproduction during the following season will be entirely absent.

(3) The most remarkable effect of the frost has been that a large number of trees, especially those which have thin bark, like karil (Capiaris aphylla) have dried up. Acacia arabica (kikar), Prosopis Spicigera (jand), Silvadora (wan) have produced no seed at all. The growth of young plants and coppice shoots has been checked and many of them have dried up.

V.—ON THE DAMAGE DONE TO THE FOREST GROWTH IN THE PILIBHIT DIVISION.

COMMUNICATED BY THE CONSERVATOR OF FORESTS, OUDH CIRCLE.

The damage caused by frost in the forests of the Pilibhit Division in 1904-05 is far in excess of that in previous years. The species which suffered most are—

Shorea robusta ...	...	...	(Sal)
Terminalia tomentosa	...	...	(Assaina)
„ belerica	...	...	(Bahera)
Buchanania latifolia	...	...	(Piar)
Phyllanthus emblica	...	...	(Aonla)
Stereospermum suaveolens	...	...	(Pandor)

The species which suffered least are—

Eugenia Jambolana	...	...	(Jamun)
„ operculata	...	...	(„)
Wendlandia exserta		..	(Birsa)
Diospyros tomentosa	...	...	(Tendu)

The sal suffered most in the open blanks which occur very frequently in these forests and are called "Chanders." In these Chanders the sal seedlings are annually killed back by the frost. In the following year the plant sends up coppice shoots, which are in their turn killed off by the frost. Occasionally a few of these shoots escape, and if they are fortunate enough to escape for several years, they grow up out of reach of the frost and so develop into trees. This year thefrost destroyed, in addition to all the small shoots, all those which had escaped for several years, and in some cases sal trees up to 35 ft. in height were killed. Round the edges of the Chanders, where the young sal trees are generally protected from the frost, great damage was caused this year.

The frost even penetrated right into the forests and killed off young sal trees standing under a fairly dense canopy. In many places the twigs of the lower branches of big trees dried up. The total absence of fruits of the Terminalia belerica, Phyllanthus emblica and Buchanania latifolia in some places this year is said to be the result of the frost. The sal does not seem to have been affected in this way, and has seeded profusely.

The damage by frost is more apparent in the southern parts of the Division. The northern parts, which are closer to the hills, have not suffered so much.

THE PÁTLI DUN.

Mr. Hobart-Hampden has very kindly furnished the following information on the subject of our frontispiece, which is from a photograph taken by Mr. F. Beadon Bryant, Conservator of Forests, showing the scenry in the Pátli Dun: "The scene represents Boxar on the Ramganga River at the lower end of the Pátli Dun in the Garhwal Division of the Western Circle, United Provinces. The Pátli Dun is a flat open plain bordering the Ramganga from about eight miles above Dhikálá down to Boxar and is surrounded with sal forests.

EFFECTS OF THE EARTHQUAKE OF APRIL 1905 IN FATEHPUR RANGE, KUMAUN FOREST DIVISION, CENTRAL CIRCLE.

M. S. RAWAT

FOREST RANGER, KUMAUN DIVISION.

Though the effects of the earthquake which occurred on the 4th April 1905 have been on the whole alarming, yet it is an ill-wind that blows no one any good, and the shock has not been without benefit to some people.

There is a place named Chaunsila, *12 miles from Naini Tal.* Here the inhabitants annually incurred great difficulties in procuring a supply of water for drinking and other purposes. Every year at the close of the winter season the water in the stream became less and less every day until by the beginning of May not a drop was to be found for two miles in each direction. Owing to this the people of some two or three villages yearly suffered great trouble and calamity, and it was due to this want of water that the Forest Rest-house was erected at Fatehpur instead of being built at Chaunsila.

This year whilst the rest-house was being put up at Fatehpur suddenly the great earthquake of 4th April 1905 occurred, and the shock removed the trouble both of the inhabitants and of the weary travellers who, marching through this area in the summer, could procure no water to quench their thirst for eight long miles. From the date of the occurrence of the earthquake a large amount of water has been flowing throughout the whole of the dry season.

Owing to the same cause the volume of water in three streams, *i.e.*, Deigaon Sot (Dechauri Range), Tilaur Sot and the Nehal (Fatehpur Range), has been increased to about three times their original supply. I have been watching this increased supply throughout the hot weather, and I have hopes that it will continue permanently.

NAINI TAL, 31*st July* 1905.

THE PREPARATION OF RUBBER AT MERGUI, TENASSERIM.

The following notes upon the preparation of rubber at the Mergui Plantations in Tenasserim have been *kindly forwarded* by the Inspector-General of Forests. They are extracts from a letter from the Conservator of Forests (Mr. F. B. Manson), Tenasserim Circle :—

The term "wet process" for the preparation of the rubber is used in contradistinction to the process of curing by hot air and smoke in Mr. Wickham's machine.

2. The wet process in use at Mergui Experimental Gardens is the simplest possible method and yields very clean rubber. The fluid latex strained, but without any admixture of chemicals but diluted with water, if too thick, is set to cream in soup-plates. The rubber particles, which are of lower specific gravity than sap, gum, etc., rise to the surface whilst the watery constituents of the latex and impurities sink. After about 24 hours or less the rubber forms a soft creamy white cake, which is removed by hand pressed, stamped *with the plantation mark, washed and then placed on* well ventilated racks under a shed to dry. I should mention that after the cakes of rubber are removed from the soup-plates the residual liquor, which is usually slightly milky, is collected along with the washings of the collecting cups in larger vessels, some clean water is added, if necessary, and the mixture stirred. After standing for 24 hours or so a certain quantity of rubber rises to the surface. This is carefully washed and dried, and is sold along with the scrap. I contemplate treating this quality of rubber *eventually* in a washing machine and exporting it in the form of sheet-rubber. Manufacturers, however, seem to be quite content with the "pancake" or biscuit rubber now sent from plantations.

The quantity of latex at present dealt with is inconsiderable, being derived only from the older trees in the Experimental Gardens. It is not sufficient to warrant the purchase of expensive machinery, but I am of opinion that some simple machinery and drying apparatus will be needed in a few years' time as all labour available will be required for collecting the latex. I have

accordingly made enquiries through the International Rubber Planters' Association, of which I have become a member, with a view to improving our present primitive methods of preparation and hastening the drying process. As this concerns our methods of preparation I beg leave to enclose a copy of my letter of enquiries, and to refer you for the sequel to the *India Rubber Journal* of the following dates :—

16th January, correspondence *re* Washing Mills.

13th February, page 169, "A Question for the Rubber Trade."

27th February, page 222, "Washed and Dried Rubber."

13th March, page 269.

It is possible that it may be found profitable to adopt the centrifugal separation of the rubber particles from the latex diluted with water (Biffen's patent) or a modification of it which is announced from Ceylon; but until a considerable number of the plants in the larger plantation are large enough to be tapped it will, I consider, be sufficient to go on as we are doing.

I beg to append extracts from my last inspection notes of the Mergui Plantation relative to the preparation, drying, and packing of the rubber, and the account sales of the last two consignments, from which it will be seen that our rubber fetches excellent prices. The price of Fine Para opened at 5*s.* 1*d.* in 1905 and in the second week of March stood at 5*s.* 5*d.*

Extract from Inspection Report on Rubber Plantation at Mergui.

* * * * *

THE PREPARATION OF RUBBER.

3. The preparation of the rubber has been vastly improved by the Manager (Mr. J. W. Ryan), but still leaves room for further improvement. For example, the biscuits are of various shapes and sizes, some being very thin and shrivelled up. It is desirable that all should be as nearly as possible alike. Moulds of several kinds have been tried, but they do not give better results than the ordinary soup-plates. Plates of the same size and make should be used so that the pancakes may be the same. A measure or ladle should be used for putting an equal quantity of latex in each

plate so as to obtain cakes of equal thickness, say, eight to the pound.

The marking of the pancakes or "biscuits" may be, and to some extent is, done by hand by pressing each cake with one of the plates originally intended to be used in the moulds. This is a slow and expensive method which will be improved upon when the yield increases. The cane hammocks on which the pancakes are hung to dry are allowed to sag too much, so that the cakes of soft rubber become deformed and unsightly. If the cane will not bear stretching tight it will be better to use wire-netting, say of two-inch mesh, on which the cakes of rubber will lie flat. The pancakes when removed from the plates or moulds are very soft and of a creamy white colour. I noticed that the liquor which moistens them is sticky and gives the cakes a sticky coating apparently of some gum-resin, which is very apt to get mouldy in damp weather. This must be remedied either by diluting the latex before it is poured into the plates or by throwing the pancakes into clean water and washing them when they are taken out of the moulds. It will also be a good plan to subject them afterwards to pressure so as to squeeze out moisture and imprint the Government mark upon them before putting them on the racks to dry.

SOME RECENT RUBBER SALES FROM MERGUI.

Account sales of four packages India Rubber shipped by the undersigned per ss. "Derbyshire" to London, sold by order and for account and risk of the concerned.

Forest Department Rubber Consignment Account No. 6, Invoice 170. 1903-1904. shipment.

		Cwt. qr. lbs.	£ s. d.	£ s. d.
H1 1 case gross ...	...	1 1 11		
T/D 38/2 ...	...	0 1 12		
Nett ...	...	0 3 27		
	111 lbs. @ 5/1		28 4 3	
H2 1 case gross	...	0 3 18		
T/D 42/2 ...	...	0 1 16		
		0 2 2		
	58 lbs. @ 4/5	...	12 16 2	
H3 1 case gross	...	1 1 1		
T/D 40/2 ...	...	0 1 14		
		0 3 15		
	99 lbs. @ 5/1	...	25 3 3	
H4 1 case gross	...	0 1 0		
T-D ...	..	0 0 2		
	26 lbs. @ 4/6	...	5 17 0	
			72 0 8	
Discount allowed to buyers 2½ % ...		...	1 16 0	70 4 8
Home Charges.				
Freight on 3-2-5 @ 52/6 ...		...	0 10 10	
Landing, weighing, taring and sampling		...	0 16 9	
Wharf rent and Fire Insurance ...		...	0 1 8	
Porterage, stamps and petties ...		...	0 2 5	
Brokerage @ 1 %		..	0 14 5	
Commission 5 %		...	3 12 0	5 18 1
				64 9 7
			Rs. a. p.	Rs. a. p.
Exchange for o/d remittance to Rangoon 1/4		...	...	961 3 0
Rangoon Charges.				
Marine Insurance		...	4 9 0	
Shipping and petty charges ...		...	10 10 0	15 3 0
	Nett proceeds	...	...	946 0 0

RANGOON: E. & O. E.

20th July 1904. (Sd.) FINLAY FLEMING & CO.

Account sales of six cases India rubber shipped by the undersigned per ss. "Warwickshire" to London for sale on account and risk of the concerned.

Invoice No. 187, Forest Department Consignment No. 7, 1903-1904 shipment.

	Cwt. qr. lbs.	£ s. d.	£ s. d.
1/4 = 4 cases gross	4 0 9		
Less T 136 + D 8 lbs.	1 1 14		
	2 3 5		
= 313 lbs. @ 5 3½	...	82 16 4	
5 1 case gross	0 3 25		
Less T 43 + D 2	0 1 17		
	0 2 8		
= 64 lbs. @ 5/3	...	16 16 0	
6 = 1 case gross	1 1 15		
Less T 41 + D 2	0 1 15		
	1 0 0		
= 112 lbs. @ 4/11	...	27 10 8	
7 = 1 bag gross	0 0 11		
	0 0 1		
	0 0 10		
= 10 lbs. @ 3/8	...	1 16 8	128 19 8
Less discount 2½ %	...	3 4 6	
Interest allowed to buyers	...	0 3 5	3 7 11
		...	125 11 9
Home Charges.			
Freight	...	1 1 8	
Landing, weighing, taring, opening for customs, etc.		1 11 0	
Rent	...	0 1 0	
Fire Insurance	...	0 2 1	
Porterage of sample, stamps and petties	...	0 1 0	
Brokerage @ 1 %	...	1 5 9	
Commission @ 5 %	...	6 9 0	10 11 1
			115 0 3
		Rs. a. p.	Rs. a. p.
At exchange 1/4$\frac{1}{32}$	...	...	1,721 13 0
Rangoon Charges.			
Marine Insurance	...	7 6 6	
Shipping and petty charges... ..	...	21 5 6	28 13 0
Nett proceeds	...	...	1,693 0 0

RANGOON: E. & O. E.

12th November 1904. (Sd.) FINLAY FLEMING & CO.

SCIENTIFIC PAPERS.

SOME INDIAN FOREST FUNGI.

PART II.

BY DR. E. J. BUTLER, M.B., F.L.S.,

CRYPTOGAMIC BOTANIST TO THE GOVERNMENT OF INDIA.

A number of exceptionally interesting fungi of the order Uredineæ, more commonly called rusts, occur in the Himalayan forests. They are perhaps the best known of all Indian fungi from the work of the late Dr. Barclay of the Indian Medical Service, who in the short space of six years, from 1886 to 1891, published over twenty papers dealing with these fungi, and described 109 species, of which 72 were new to science. It has since become clear that he only touched on the fringe of a vast subject. Almost all his species were collected in the immediate neighbourhood of Simla, and as we pass along the range the variation of the fungus flora keeps pace or perhaps exceeds that of the general flora. The Mussoorie and Jaunsar barberries, for instance, bear an entirely different Æcidium from that on the Simla ones. A few scanty observations around Darjeeling have convinced me that the rusts of the Sikkim Himalaya differ widely from those further west. I believe that the Himalayan range is one of the richest regions of the globe in the members of this group. They have, however,

almost escaped the attention of collectors. The Sikkim species are practically untouched, and our knowledge elsewhere, excluding Simla, is confined to the most conspicuous forms in a few easily accessible spots.

It is necessary, in order to render intelligible the following notes, to deal briefly with the general characters and often complicated life-history found in the order. All are parasitic, and the most destructive of known fungus diseases of cultivated plants are caused by the members of this group. Such are the rusts of cereals, annually responsible for the loss of millions in the grain-producing countries, the coffee leaf disease, which destroyed the planting industry of Ceylon some forty years ago, the linseed rust, exceedingly destructive in India, and many others. Most are confined to a single species or to a few closely allied species of host; the host being almost invariably a flowering plant. Unlike the fungi with which we are chiefly familiar, such as the mushrooms and moulds, which can get their food from a variety of substances, the rusts require food of a definite composition, and usually find it only in one or a few living plants. It speaks volumes for our ignorance of the true composition of living plant substance that their artificial cultivation has never yet been accomplished. But the most remarkable phenomenon in the group is that known as "heterœcism" or the passing of different stages of the life-history on different and often widely separated host-plants. It is an eccentricity entirely comparable to that of the parasite of malarial fever in man, which, as we know, is obliged to pass a portion of its life in the body of the mosquito. Within recent years science has had its interest awakened in this class of parasite, and we may expect to find other diseases due to the development of so objectionable a character, long known however in the fungi and some lower animals, added to dengue, sleeping sickness, yellow fever, malaria, &c. Another phenomenon exhibited by the rusts which may also have its counterpart in the parasites of man is that of "specialisation." Some of the species which attack several hosts have got split up into races without any external difference but each confined to its own variety of host and

unable, without some difficulty, to attack the hosts of the others. It is as if we should imagine that plague, to which Europeans are now comparatively immune, but which once ravaged Europe (if indeed the Black Death were plague), had got from long restriction to the East developed into a race no longer capable of readily attacking whites, while the parasite in Europe had gradually died out completely. The black rust of cereals attacks both wheat and oats, and the forms are absolutely alike, and beyond doubt are of one origin; yet that on wheat cannot pass to oats, in India at any rate, and as the race on oats has not yet been introduced here, we commonly have, as in Dehra Dun, the remarkable sight of fields of wheat severely attacked with black rust alongside oat fields where not a trace of the disease can be found.

In the life-history four stages are usually recognised. These may all be passed on the same plant or some may be passed on one plant and the others on another. They are known as the æcidial, uredo, teleuto and sporidial stages.

The æcidial stage, or Æcidium, consists of a little plant body or mycelium formed of thread-like cells running between the cells of the host plant and obtaining food from them by means of little suckers pushed through their walls. It is usually found infesting leaves, but sometimes occurs on shoots, flowers and fruit as well. It is marked by the formation, as reproductive bodies, of æcidiospores, usually minute, yellow, spiny bodies enclosed in a cup-like receptacle, of which the cluster cups of the barberry are a more or less familiar example. With these a second spore-form, the "spermatia," whose meaning is not clear, is often found. On germination the æcidiospores usually give rise to the uredo stage.

The uredo stage also consists of a mycelium much like the first, but it gives rise to uredospores which differ in colour, size, shape or some other character from the æcidiospores. They are formed under the epidermis and are without the little cup-like receptable.

The teleuto stage arises from the same mycelium usually as the last stage, and the two together may therefore be taken as forming one stage only. Teleutospores are formed usually after

the uredospore production has finished, but sometimes amongst the latter. Unlike the two preceding, the teleutospore is often composed of more than one cell, and instead of being able to germinate immediately it is frequently a "resting-spore" requiring a lapse of several months from its formation before it germinates.

The sporidial stage results from the germination of the teleutospore. Instead of a mycelium being formed within the plant, a short projection grows out from the teleutospore into the air, and on this a few small spores, the "sporidia," are produced. On germination the sporidia give rise immediately to the Æcidium again.

Now the remarkable fact remains that the æcidiospores on germination are often unable to produce the next stage unless they happen to fall on a different plant to that on which they were borne. Thus the barberry cluster-cup spores cannot attack the barberry itself, but if they come into contact with wheat, barley, oats, etc., they complete their development by giving rise to a mycelium within these plants, eventually bearing uredo and teleutospores and causing the destructive black rust of cereals. Similarly the sporidia resulting from these teleutospores cannot infect a cereal plant, but only a barberry. Just as a malarial parasite in the blood of man must die with its life but half completed unless a mosquito should suck it up, so the sporidia are obliged, in order to complete their cycle, to come into contact with a barberry bush. But as it appears probable that the malarial parasite can live in one stage for many years and induce ague in man years after exposure to mosquito bites has ceased, so also it is certain that the uredo stage of some rusts can be reproduced for years without the intervention of the other stages.

So much being clear, the description of some species which I have received chiefly through the kindness of Forest Officers can be proceeded with.

CHRYSOMYXA HIMALENSE, BARCLAY.

In two papers in the "Scientific Memoirs by Medical Officers of the Army of India," in 1890 and 1891, Barclay described some Uredineæ on Himalayan species of rhododendron, and discussed their relationships, which were rather puzzling.

Around Simla a teleutospore form, which Barclay named Chrysomyxa himalense, is extremely conspicuous on Rhododendron arboreum. Comparing it with its European relative Chrysomyxa Rhododendri, D. C., Barclay sought for its æcidial stage on Pinus excelsa and on Picea Morinda. In Europe the Æcidium of the Rhododendron Chrysomyxa occurs on Picea

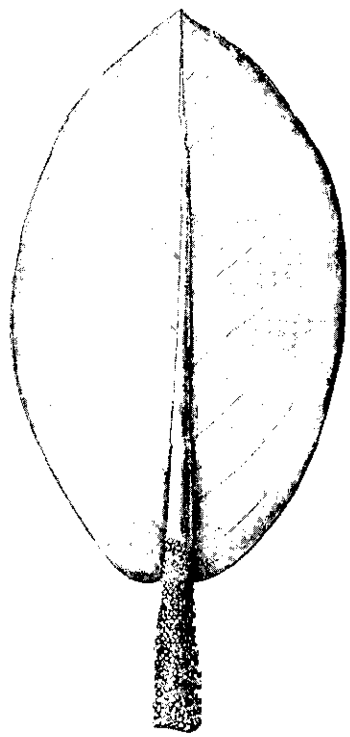


FIG. 3.—CHRYSOMYXA HIMALENSE ON RHODODENDRON CAMPANULATUM.

excelsa. In India, however, Barclay could get no experimental evidence that his Chrysomyxa was connected with any conifer.

Later on he obtained an Æcidium on Rhododendron campanulatum and a Uredo on R. lepidotum, and the possibility immediately presented itself that the three stages of

his Chrysomyxa were passed on the rhododendrons without the intervention of any other plant.

In specimens received from Mr. Hole, I. F. S., from Jaunsar in 1904, the teleuto stage of Chrysomyxa himalense was found by me on Rhododendron campanulatum.

Sir G. Watt also stated in a footnote to his Review of Dr. Barclay's works published in the 'Agricultural Ledger' in 1896 that he found an Æcidium on R. lepidotum which Dr. Barclay declared solved the mystery of these fungi. This it could only have done by proving identical with that on R. campanulatum. Hence we have *an æcidial and a teleuto form co-existing on Rhododendron* campanulatum, and probably the same Æcidium and a uredo form co-existing on R. lepidotum. The possibility suggested by Barclay that this fungus passes through all its stages on the rhododendrons therefore becomes a probability, and the theoretical interest of this is considerable.

The origin of the remarkable power of changing hosts ("heterœcism"), such as is found for instance in the case of the malarial parasite and in many rust fungi, has naturally given rise to much speculation. Anything throwing light on it is therefore of value. Some have supposed that it is capable of explanation on the descent theory, the parasite having affected the two different hosts from the time of their common ancestor. In the case of the mosquito and man this takes us very far back indeed, and for the rust fungi we should have to look even farther. Others suppose that the parasite originally attacked both hosts and completed its development on each, subsequently losing one portion of its stages on one host and the remainder on the other. But the most probable view appears to be that which considers that the parasite was originally confined to one of the two hosts, and only later, by a sudden adaptation, became capable of passing to the other.

It so happens that European rhododendrons bear, as already mentioned, a fungus, Chrysomyxa Rhododendri, which has its æcidial stage on the spruce, Picea excelsa. The spruce also bears the teleuto form of a second fungus, Chrysomyxa abietis.

The two are sufficiently alike to suggest a common origin. Any evidence that the rhododendron species was originally confined to one host will therefore throw some light on the development of heterœcism in this case. It may either have been at first confined to the spruce and then have passed to the rhododendrons in its uredo-teleuto stage, or at first living on the rhododendrons have then emigrated to the spruce in its æcidial stage. Now, though the fungus on Himalayan rhododendrons is unlike that on the European ones in many respects, still it is not unreasonable to consider that it also is of common origin with the latter. It would *then strongly support the second of these views. In the Himalaya*

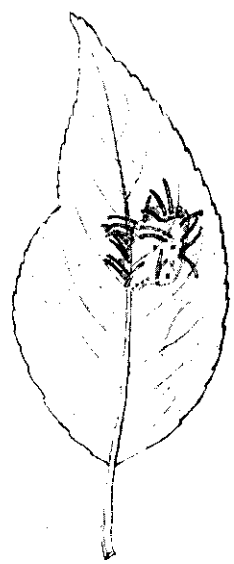


FIG. 4.—GYMNOSPORANGIUM CUNNINGHAMIANUM, ÆCIDIUM FORM ON PYRUS PASHIA.

at least, it is now probable that the rhododendron Chrysomyxa was primitively, as at present, confined to the rhododendrons. We may then suppose that in its passage westward it developed Chrysomyxa Rhododendri by the transfer of its Æcidium to the spruce. From this Æcidium a teleuto form arose on the spruce giving rise to Chrysomyxa abietis. Hence a competition ensued

on the spruce between the Æcidia of Chrysomyxa Rhododendri and of Chrysomyxa abietis, and, as Barclay has pointed out, in such a case the heterœcious form is the more likely to succeed. So the Æcidium of Chrysomyxa abietis was lost. The German mycologist de Bary was the first to suggest that Chrysomyxa abietis originated from a form living on the rhododendrons, and Barclay showed that such a form possibly occurred in the Himalaya. The discovery of the æcidial and teleuto stages both on R. campanulatum renders such a view at least highly probable.

GYMNOSPORANGIUM CUNNINGHAMIANUM, BARCLAY.

One of the commoner rusts in Mussoorie is an Æcidium on Pyrus Pashia, the Himalayan wild pear, which is conspicuous on the

FIG. 5.—GYMNOSPORANGIUM CUNNINGHAMIANUM, TELEUTO FORM ON THE CYPRESS.

older leaves during the hot-weather months, in and around the station. The affected leaves bear orange-red patches, which may be half an inch in diameter on the upper surface.

On these spermagonia are formed, showing as tiny black dots, while the corresponding part of the lower surface bears little tubular Æcidia from one to two millimeters long.

The species also occurs at Simla, where its life-history was followed by Barclay. Its further development occurs on the Himalayan cypress, Cupressus torulosa.

After infection by æcidiospores from Pyrus Pashia the cypress develops teleutospore beds at the infected part, either on the branches or green twigs

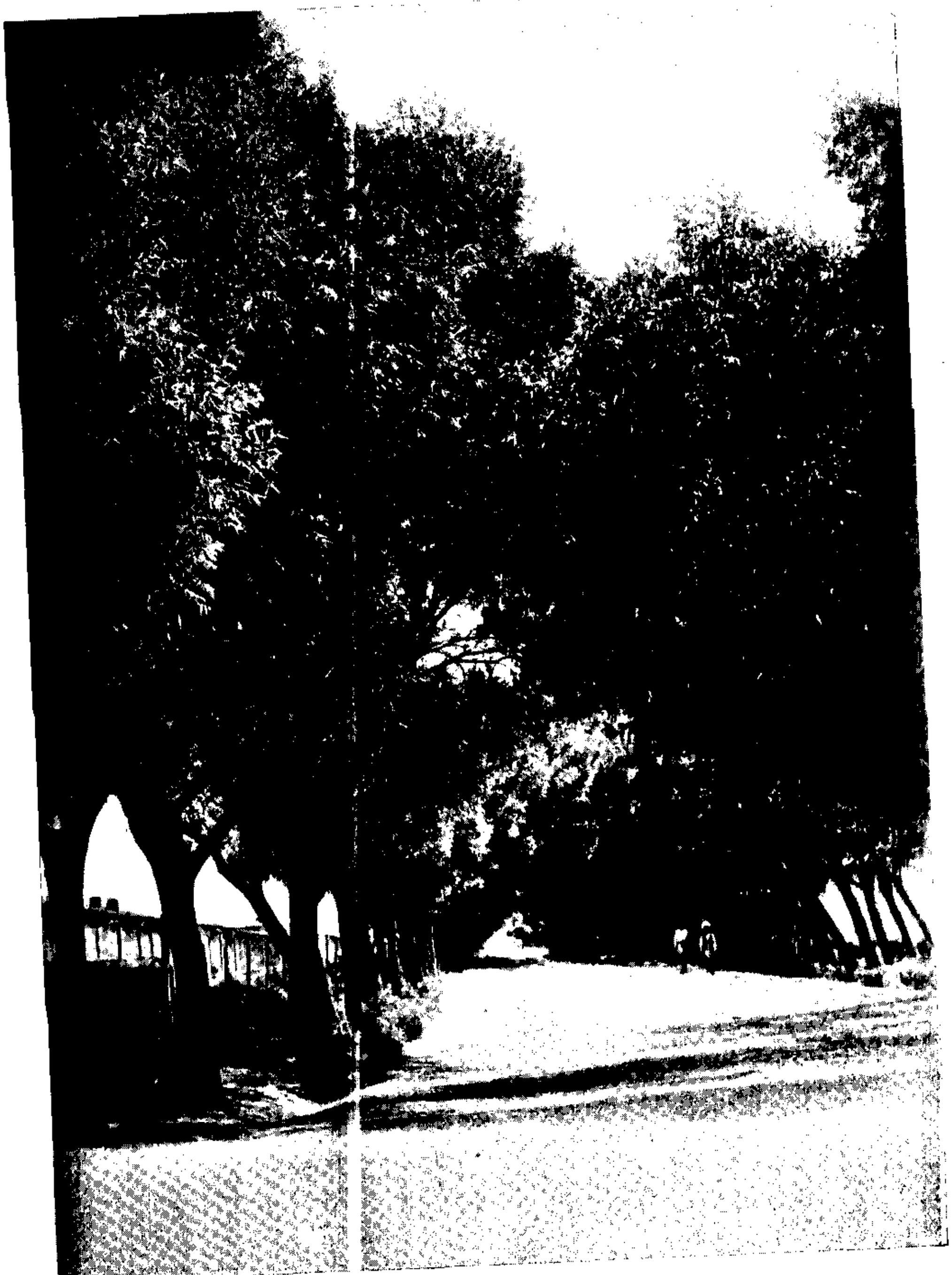
These beds are hemispherical or elongated, dark brown, bodies which during moist weather swell up enormously into gelatinous masses; later on they become yellowish in colour from the formation of sporidia on promycelia given out by the germinating teleutospores. By sowing the sporidia Barclay caused first spermagonia and then Æcidia to appear on the leaves of Pyrus Pashia.

In June 1904, Rai Sahib U. Kanji Lal, Vernacular Instructor at the Imperial Forest School, sent me some specimens of this fungus on cypress seedlings, and wrote that it was doing much harm in Jaunsar to young trees, especially those planted. Some of the seedlings sent were evidently dead from the effects of the parasite.

A European ally of this species, known as Gymnosporangium Sabinæ, is found on the juniper in the teleuto stage and on the pear tree in the æcidial stage. It causes much damage to the latter, but the destruction of the juniper trees in the neighbourhood of the orchards has, in several cases, led to the disappearance of the disease.

In Jaunsar it is possible that something of the same sort might be attempted wherever the cypress plantations are being much injured by this fungus. Removal of Pyrus Pashia for some distance around would probably lead to a considerable reduction in the cypress parasite in a few years.

(*To be continued.*)



Avenue of Kandahari Willows, near the Siestan Caravanserai, Quetta.

ORIGINAL ARTICLES.

THE AVENUES AND FRUIT GARDENS OF QUETTA.

BY E. P. STEBBING.

The popular and extremely pretty station of modern Quetta occupies the central highland of Baluchistan. Holdich considers that from its geographical position it must always have been a point of strategical importance as well as a considerable commercial centre. It is surrounded by gigantic mountain peaks running to 11,700 feet of elevation, the highest that Baluchistan can boast, and only eclipsed by the weird and isolated snow-capped volcano, the Koh-i-Taftan of the Persian border. Quetta is situated at an elevation of 5,500 feet above sea level, and is surrounded by an entourage of mountains such as few cities of the world can boast of. The double-peaked Takatu on the north is balanced by Chiltan on the south-west, whilst to the south-east the square-topped Muedar rears itself up into the heavens. Beyond this again to the north-east the ramparts of Zarghun close up the landscape; curious barren mountains these, blazing scarlet in the winter sunsets. From a point not far away the silver cone of Kand, which parts the headwaters of Pishin from those of Zhob, can be seen. The Mushkaf-Bolan Railway, on its way up from Sibi, runs through a dreary waste of sandy desert, covered in parts with a coarse herbaceous growth, and rocky mountains until the plain of Quetta and the valley of Pishin are reached. The result of British interference with frontier misgovernment has, by means of irrigation, in the space of a short quarter of a century, converted plain and valley in spring and summer into a green oasis amongst the mountains. Wide green vistas of crops, broken here and there by the dark patches of orchards and hamlets and forming a grateful alleviation to the surrounding howling wilderness of desolation, are now to be seen from the top of the Miri, supposed by Holdich to be the ancient débris of a mud volcano*

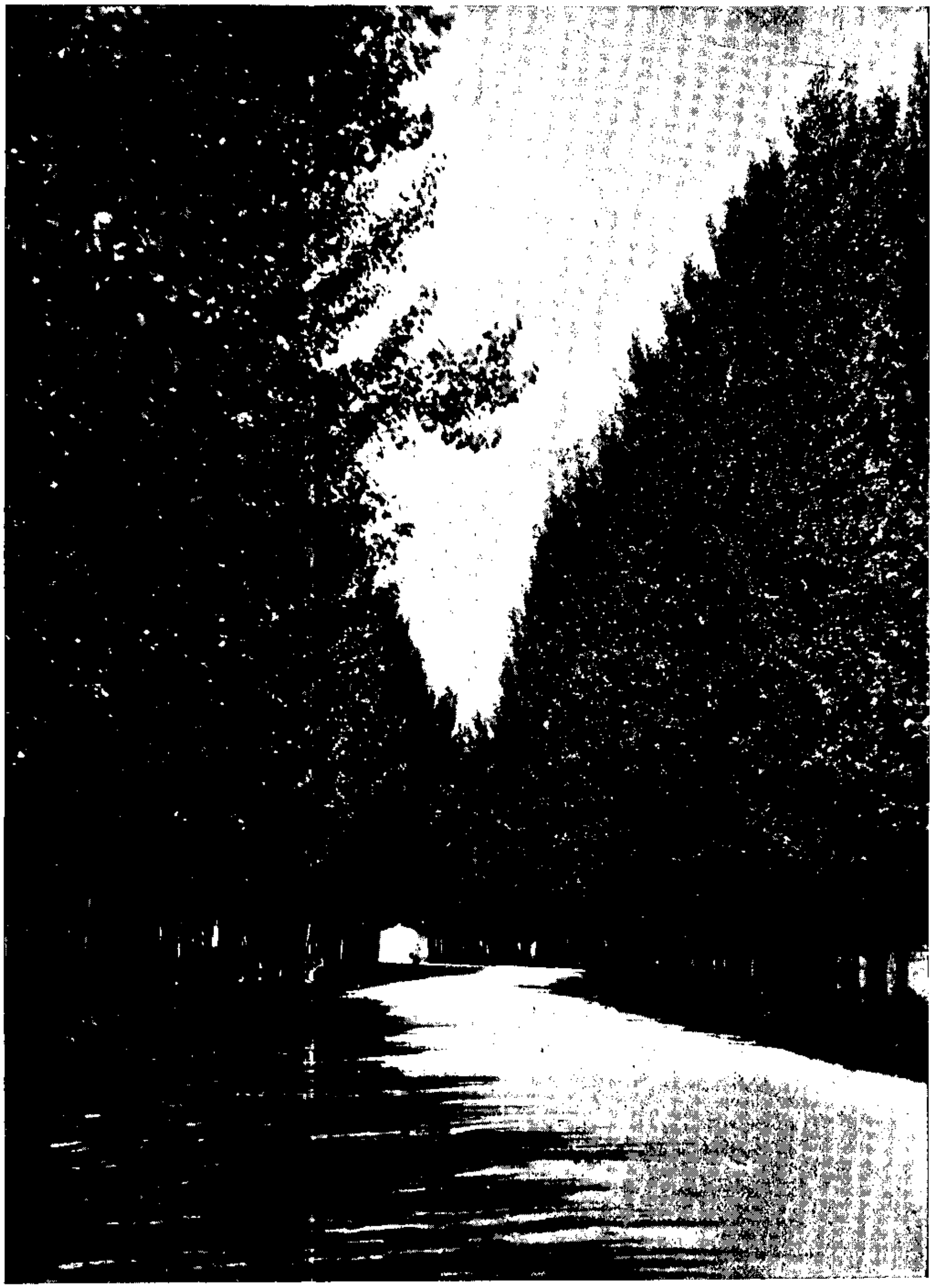
* Holdich in his 'Topography of British India' (The Regions of the World Series) alludes to the Miri as the 'ancient débris of mud volcano.' Mr. R. Hughes-Buller informs me however that excavations have shown it to be artificial.

which dominates Quetta as its fortress and protection. But delightful as are these smiling fields and orchards they are almost eclipsed by the beautiful and magnificent avenues which border the roads of the station itself. These are solely the result of the work and foresight of the first generation of Quetta's rulers, ably continued by their successors.

The great need and importance of arboriculture in India has recently been the subject of a Resolution of the Government of India, to which attention has already been drawn in the *Indian Forester*.* Nowhere perhaps throughout the length and breadth of the great continent are its enormous benefits to mankind in general so strikingly demonstrated as in the wonderful results achieved in Quetta. The illustrations with which this article is supplemented will, it is considered, sufficiently support this contention. Having been much struck, during a recent visit to the station, with the manner in which the planting work had been carried out, enquiries were instituted with a view to the possibility of writing a note upon the subject. Acknowledgment is here made of the kindly assistance received from Major Archer, Judicial and Revenue Commissioner, Baluchistan, and Major Tighe, Political Agent, Quetta; from General Smith-Dorrien, C.B., D.S.O., and General Sir Stanley Edwardes, K. C. B., the first G. O. Commanding Quetta, through his son Major S. M. Edwardes, D. S. O.; also incidentally from Sir Hugh Barnes, K.C.S.I., whom he consulted on the subject. As we shall see, both these latter officers were the prime movers in the original planting up of Quetta. To all these officers, as also to Mr. R. Hughes-Buller, C.S., Superintendent of the Baluchistan Imperial and District Gazetteers, and Rai Saheb Diwan Jamiat Rai, sincere thanks are due for the aid which has rendered the compilation of this note a possibility.

Sir Stanley Edwardes informs me that the trees at Quetta, when the British first arrived, consisted mainly of orchards of white mulberry and apricot. There were no large trees at all except some scattered mulberry trees in the vicinity of the fort,

* *Vide* p. 460 of the present volume.



White Poplar (Populus alba) Avenue, Woodcock Spinney, Quetta.

in what is now the General's compound, and also near the alignment of the present Lytton Road (in the Residency grounds), and some old willows (Kandahari ?) which stood to the west of where the railway station now stands near the site of the present railway Dhobies' Ghat.

The first steps towards planting up the station appear to have been initiated in the Civil Lines by Mr. Bruce as far back as 1878. A year later Mr. Ingle joined as Treasury Officer and Cantonment Magistrate, and continued the work both in the Civil Lines and Cantonments. Later on, after the evacuation of Kandahar, the work was taken up in a more serious fashion by Mr. (now Sir Hugh) Barnes, with whom was associated the late Colonel Gaisford; a Tree Committee being formed. Mr. A. Waston, Assistant Conservator of Forests in Baluchistan, also took a considerable part in the formation of nurseries and in the roadside planting.

The first young trees were obtained from Kandahar. Captain Anscomb, Assistant Commissioner, Quetta, to whom I am indebted for much valuable information on the subject, confirms this statement. He says that a beginning was made in the winter of 1881-82, when some 60,000 cuttings of chinar, poplar (*Reamer* variety) and willows were brought on camels from Kandahar and planted out along the roadsides and in gardens. The chinar cuttings were chiefly placed upon the Lytton Road, where they now form the beautiful shady avenue depicted in plate XLIII. The cuttings were put out in trenches, the latter being watered by irrigation channels. Water in such a country as Baluchistan is a commodity of which the value is fully understood; and very considerable skill has been shown in Quetta in making use of the amount available to raise and keep alive the beautiful avenues. The wonderfully rapid growth of the trees has exceeded all expectations. The white poplar and Kabul willow cuttings, neither of which trees Sir Stanley informs me (although now so plentiful) existed at Quetta when the British arrived, were put out upon the other roads of the station; poplars, and to a lesser extent willows, were also planted out in the grounds attached to the Residency and the General's

quarters, and other private compounds. These first batches of cuttings were procured by the Political Officers, and others obtained in the same way were planted out in Cantonments by Sir Stanley. From such first beginnings have the beautiful Quetta avenues arisen, and the wonderfully rapid growth, which is so well shown in the accompanying illustrations, has proved a most pleasant surprise to some of its original originators whom distance and retirement have long since removed from the scene of the labours of their earlier days. This wonderful growth has, however, another aspect and affords food for serious reflection; for is it not typical of what can be done in Baluchistan under careful supervision and is it not a good augury of what may be done in the future in many parts of the country? The question is one of water, but how many irrigation channels—kutcha irrigation channels—are there in the various districts flowing unprotected through the porous soil under a hot sun? It is often held that planting trees along an irrigation channel is to be avoided owing to the amount of water they absorb. This is true under certain conditions, but only under certain conditions. In Baluchistan these conditions are not present. The amount of water lost by percolation through the earth channels and absorbed by the rays of the hot sun must be enormous. The planting of trees—trees to provide timber or fuel and trees to yield that exquisite fruit which this land, truly the fruit garden of India, will grow so abundantly would not only prevent so large a loss of water but would utilise usefully the amount which does percolate.

On the subject of the tree growth present in the villages in the vicinity of Quetta on our arrival there, Captain Anscomb writes "The village of Kansi lying to the south-east of the town was the only village in the *immediate* neighbourhood. It contained orchards of apricot, apple, plum, grape, and mulberry trees; and there were a few willows, white poplar (*Safedas*) and *Reamer* poplars. The villages of Kirani and Sariab, the former lying about four and a half miles south-west of the town, and the latter about eight miles due south, were well stocked with trees. In Kirani there were mostly fruit trees with a few willows along the water channels and small

Avenue of Kabul Willows on the Jail Road, Quetta.

clumps of mulberries; while those in Sariab were mostly mulberry and willow with a few apricots. There were very few trees in the Quetta plain when I came (in May 1881), and I believe that to have been the case when the British arrived."

As the planting work continued in the station other species of trees were introduced by degrees, and the avenues, which are mostly to a certain extent mixtures of two or more species, now contain the white or *safeda* (Populus alba), black or *kala safeda* (P. nigra), *reamer* (P. sp.) and Euphrates (P. euphratica) poplars; the Kandahar (Salix alba), Kabul (S. æmophylla) and weeping (S. babylonica) willows; the plane tree or *chinar* (Platanus orientalis); a species of ash (Fraxinus sp.) from America; elm (Ulmus sp.); mulberry (Morus alba) and apricot (Prunus armenica). In addition there are, chiefly in Cantonments, some young horse chestnut (Æsculus indica) and robinia (Robinia pseudo-acacia).

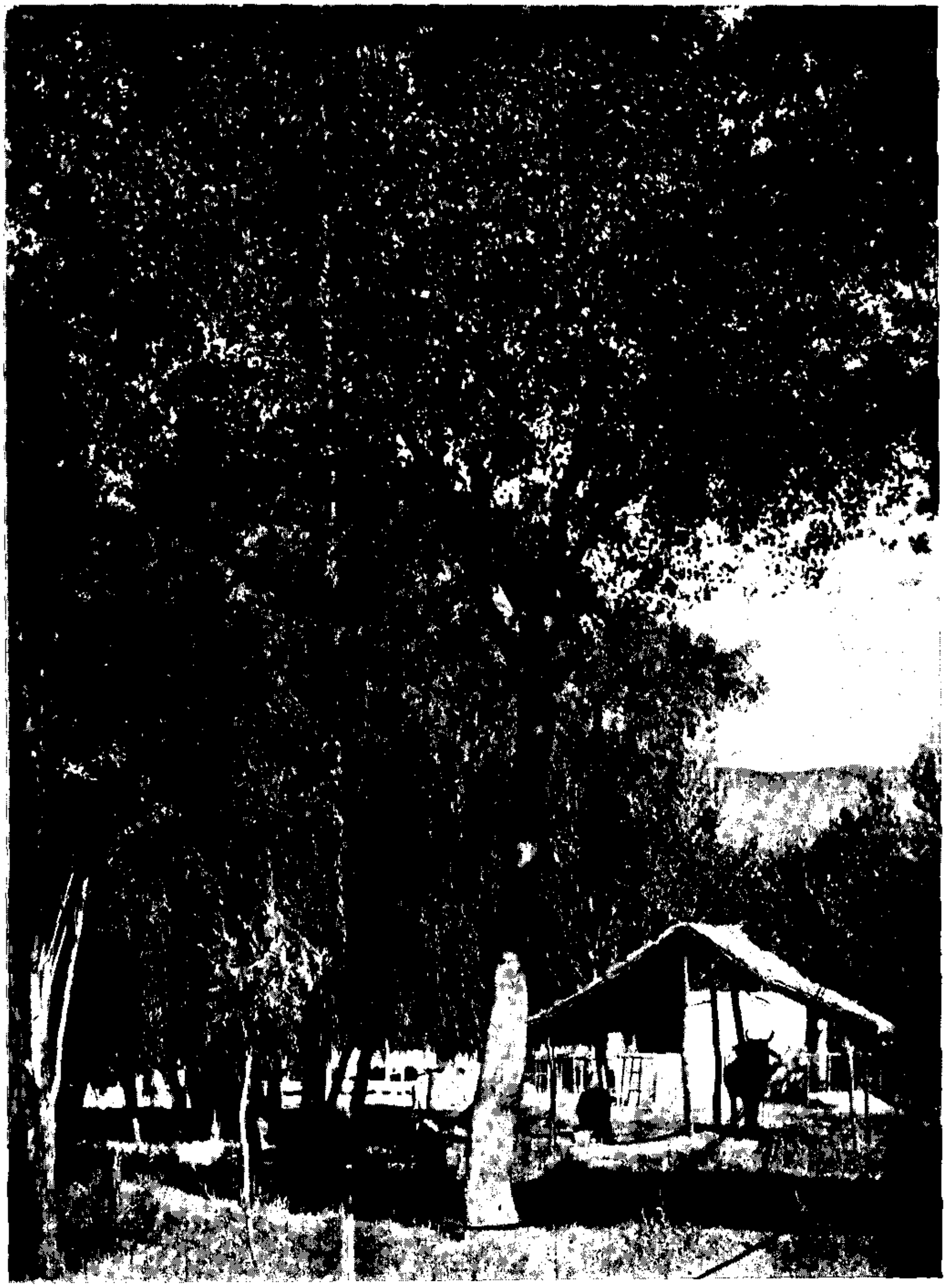
Running through the station, in Civil Lines and Cantonments alike, is the Lytton Road, the main thoroughfare of Quetta. This road was amongst the first planted, and contains white and black poplars, chinar, Kandahar and Kabul willows, young elms and ash. Of these the chinar predominates, and the presence of this tree in the avenue renders the latter the most handsome in the station.

By far the most numerous and most prominent trees are the various species of poplars, which have been largely planted. Handsome, upright, well-grown trees these, the only fault to find with which is that they have been planted too closely together, in almost pure avenues in some places, or when mixed, mixed with the shorter Kabul willows.* The Gymkhana Road is planted with a well-grown avenue of white poplar and Kabul willow, the Jail Road with white and *reamer* poplar and Kandahar and Kabul willows. Plate XLVI shows some Kabul willows in the avenue on this road. Both these roads were planted in Col. Gaisford's time between the years 1890—95. Poplars and willows also appear on a part of the Sandeman Road and on the roads within

* Unfortunately both poplars and willows are suffering from a severe attack of a boring Cerambycid beetle, *Æolesthes sartus*.

Cantonment and Municipal limits. A beautiful avenue, shown in plate XLV, of pure poplar has been planted on the main road running past the Woodcock Spinney, whilst a very typical piece of Kandahari willows may be seen near the Seistan Caravanserai close to the railway station (plate XLIV). The White Road is planted chiefly with ash, which is doing remarkably well both here and in other parts of the station. The trees were raised from seed procured apparently from America. In addition to the two species of willows the ash is to be found on the Brewery Road accompanied by some Elæagnus (*E. angustifolia*). Fruit trees have occasionally been used in the avenues as in the case of the Lytton Road and of the Sandeman Road, which is planted with apricots. This is scarcely to be advocated, since these trees never reach the dimensions required for avenue ones. In Cantonments horse chestnut and robinias have been introduced into the roadside avenues to some extent, and these species, especially the latter, whose growth is quite remarkable, promise to do well.

Turning now to the compounds we find that great care and taste have been usually displayed in their planting up. Both in the Residency grounds and those attached to the General's quarters some fine old mulberries point to the existence of this tree in the country at the time of the arrival of the British. In the Residency a considerable amount of white poplar has been planted with Kabul willow, chinar, elms and walnut. These latter are doing excellently, and the tree is one which is well worthy of considerable notice. There are also one or two beautiful species of the *Populus euphratica* here, one of which is shown in plate XLVII. Much the same species are to be found planted in the General's grounds and elsewhere throughout the station. There are a few deodar, which are said to be doing well, and Mr. Hughes-Buller informs me that the flowering of the acacias in the spring gives a touch of brilliancy and brightness to many gardens. The beautiful weeping willow has been planted in several compounds, and notably in the Cantonment garden; with its graceful drooping foliage it greatly adds to the beauty of Quetta's green lawns.



Populus Euphratica in the Residency Grounds, Quetta.

Quetta has long been famed for its splendid fruit, and it owes its reputation in this respect almost entirely to Sir Stanley Edwardes, who was practically the first introducer of the fine varieties of trees now to be found in the station. On this subject he has given me a perfect mine of information.

The white mulberry, apricots and grapes were the chief, if not the only, fruits to be found round Quetta on the arrival of the British. Mr. Hughes-Buller informs me that nineteen varieties of grape are known in the district. He is doubtful as to whether British enterprize has, as yet, done anything for viticulture. Sir Stanley obtained 200 fruit trees from Rivers & Sons, the well-known English firm of fruit-growing stock. These consisted of peaches, nectarines, plums, apples, pears and cherries; in addition there were also gooseberry, currant, strawberry and raspberry plants. Sir Stanley gave half of the trees received to the Political Department and planted the rest in the General's compound. The following history of the trees is from his own pen: "Two plants of each sort were sent, and I managed to rear one of each and of some two—of the bush fruit a dozen of each were sent. The box 9′×4′×3′ arrived at Karachi a little late in March. I had it sent to Sibi at once and up the Bolan by bullock dâk. The trees and plants had all begun to sprout, which I expected, so I had made preparations—holes dug and matting protection like extinguishers. On the box being opened the trees had white leaves. We planted them during the night and placed the covers over them. By degrees the leaves turned yellow and light green, and when they were of normal colour the extinguishers were taken off. Thus one lost very few." These trees have prospered amazingly, and Sir Stanley in later years received eloquent testimony as to the delicious delicacy of the flavour of their fruit from Sir George White and Sir Donald Stewart, both of whom followed him in the Quetta Command (Sir Donald was in Command of the Southern Afghanistan Field Force, of which the Quetta Garrison formed part) which he was himself the first to hold. Sir Stanley was also responsible for the introduction of a high class potato. "I told Rivers & Sons," he says, "to get some good sort of

potatoes, cut them in half and nail them on between the air holes in the side of the box, which they did. The potatoes were sprouting when they arrived, and I planted them and got a splendid crop—also seed, which I distributed."

At the time of planting out these English fruit trees Sir Stanley laid out an orchard of indigenous stock on which he intended grafting from the English trees. Owing to a transfer to Bombay he was not able to carry out this intention, but his idea was not forgotten, and grafting on a considerable scale has, and is, being carried out in Quetta and the neighbourhood. Since this note has reference to the station of Quetta only it would be out of place to deal here with the fruit gardens of Baluchistan, a subject which, it is hoped, it will be possible to treat of at a later date. It may be mentioned, however, that the grafting operations have met with conspicuous success, and amongst other interesting operations the European mulberry has been grafted on to the indigenous species with excellent results. So favourable is the Baluchistan climate to these methods that it has recently been proposed to endeavour to graft the valuable Italian olive on to the indigenous variety which forms a part of the forest growth of Baluchistan.

The initiation of these operations for improving indigenous stock may be said to be largely due to the efforts of the late Colonel Gaisford. Mr. Hughes-Buller writes "A great deal was done for arboriculture and horticulture by the late Colonel Gaisford, who devoted great attention to the subject. He obtained fruit trees from America, Saharanpur and Naini Tal, and got orders issued that when *tahavi* advances were made for opening up new sources of irrigation the grantee should be obliged to plant a certain number of trees along the water channels."

In taking leave of the beautiful avenues and fruit gardens of the station of Quetta we would offer the sincerest congratulations to those to whose public spirit their formation is due and to their equally energetic successors, who have carried on the work with such excellent results.

TEAK DIBBLINGS: WHY ARE THEY A FAILURE?

BY R. S TROUP, F.C.H.

For many years it has been the custom in some of the Divisions of Burma to carry out "dibblings" of teak seed in selected open localities in natural forest, with a view to obtaining teak reproduction artificially.

These dibblings consist in depositing teak seeds in shallow holes in the ground and covering them lightly with earth. The soil is usually not prepared in any way, and the dibblings are as a rule carried out in June.

In the vast majority of cases complete failure has resulted. This is often due to the selection of areas where the ground is not sufficiently exposed to the heat of the sun, but there are two other important considerations to which due prominence has seldom been given These are (1) the season of sowing; we almost invariably sow too late, whereas we ought to sow well before the first showers, that is, by the middle of April; (2) the preparation of the ground; better results than those now obtained will probably be got by burning the leaf covering, hoeing the ground before sowing, and lightly covering the seed after sowing. These points were brought out by an experiment which I carried out in 1904 at Tharrawaddy, and which but for a transfer, I had intended continuing.

The object of the experiment was to ascertain the most successful means of inducing the germination of teak seed not previously treated in any way. For this purpose eight adjacent plots were marked out *in the open*, to obtain the full effect of the sun's heat for germination, and light for subsequent growth. In six of the plots sowings were made, 100 seeds in each plot, on the 13th April; that is, before the first showers. These plots we may call A, and the manner in which each was treated is given below. In the remaining two plots sowings were made on the 23rd June, that is, after the rains had well set in; this is about the time when "dibblings" are usually carried out in the forest. These latter two plots we may call B.

The method of treatment of the plots A, and the results, were as follows :—

Method of preparation of soil and sowing of seed.			Number of seeds germinated up to date (per cent).		
			18th June.	24th June.	17th July
Area burnt (about 3" layer of leaves.	Soil not prepared ..	Seed sown broad-cast and not covered ...	26	27	28
	Soil loosened with hoe ..	Ditto ...	32	43	47
		Seed sown broad-cast and lightly covered ...	67	75	81
Area not burnt sparingly covered with dry short grass at time of sowing).	Soil not prepared ..	Seed sown broad-cast and not covered ..	*Nil.*	8*	11
	Soil loosened with hoe ..	Ditto ...	19	21	25
		Seed sown broad-cast and lightly covered.	42	42	44

By July the state of the weed growth on the plots was as follows :—

(*a*) Plots burnt and hoed up—a fair amount of grass, etc., but the teak seedlings well above it, owing to the late start of the grass and other weeds.

(*b*) Plots not burnt, but hoed up—more grass, etc., but the teak struggling successfully.

(*c*) Plot burnt, but not hoed up—somewhat similar to (*b*), but rather more grass and weeds.

(*d*) Plot not burnt, and not hoed up—tall grass and weeds, killing out the teak seedlings.

* Of these three damped off in the grass soon after germinating.

These plots A were unfortunately destroyed by accident towards the end of July, and the further history of the young teak during the rains could not be followed.

Turning to the plots B. On one plot, not prepared in any way, seed was sown broadcast and not covered; on the other the usual "dibblings" were imitated, that is, the seed was placed in shallow holes and lightly covered. These sowings were made on the 23rd June. On these plots not a single seed germinated throughout the rains: this I attribute to two main causes—(1) the seed did not get the benefit of the alternate heat and moisture at the beginning of the rains which is so essential to successful germination; (2 the soil was not prepared in any way. Even if the seed had germinated the seedlings would have had a much harder struggle against weeds than those in the plots A, which were well on by July.

These experiments are, of course, very incomplete, and to be of much value they would have to be repeated again and again to eliminate any abnormal results which might appear in a single trial. As it stands, however, the experiment appears to bring out the following facts (assuming the essential condition that teak sowings must be carried out in fairly open localities, and not under dense cover)—(1) sowings should be carried out in April, before the first showers, and not in June, as is usually done; this gives the seed the benefit of alternating heat and rain, and gives the seedlings a start of the weeds; (2) burning, loosening the soil, and lightly covering the seed gives the best results, the other methods attempted being all considerably less successful.

The question of teak sowings in forest areas is a difficult one as well as a most important one; the operation has, however, so far as my experience goes, never met with much success. It would be interesting to know the results of other experiments bearing on the subject, or of cases, with details of the methods employed, where such sowings have been successful. So far it appears that our somewhat costly *taungya* system is the only one on which we can place reliance.

A few years ago Ranger Maung San Lon carried out, on his own initiative, in the Mokka Reserve, Tharrawaddy Division,

an experiment which has proved remarkably successful, and which deserves further trial. He cleared and burned a small patch on an opening at the side of a fire-line, and in this patch he planted, 2′ × 2′, pieces of the root stocks of young teak plants dug up in the surrounding forest, trimming off the stem and the lower part of the taproot. Owing to the density of the planting, little or no tending has been necessary since the first two years, as the shade of the teak plants has kept down weeds. The growth of the teak on this patch, which I have visited from time to time, is remarkably good. Doubtless the shoots from the *root stocks were in their first year more vigorous than is the case* with seedlings, and this would give them an early start over the weed growth. This method of extending teak reproduction certainly commends itself to further trial in Burma.

MIXED SAL FORESTS AND FIRE-PROTECTION.

BY C. C. HATT, I.F.S.

One of the chief difficulties perhaps in dealing with some of the mixed sal forests of North-Eastern Bengal and Assam, which appear to have grown up under conditions widely different from those which now prevail, is to arrive at an approximate conception of what those conditions may have been. As far as can be gathered from evidence now obtainable in the forests and from reports dating back some thirty odd years, one of the chief factors which has tended to bring about these changed conditions would appear to have *been fire-protection, and an interesting point* arising in this connection is that the present condition of portions of some of these forests tends to force the conclusion that had these areas never been subject to periodical fires the regeneration of the sal would not have been so successful as it has been. It also appears possible that such a favourable opportunity for the regeneration of the sal, as occurred at the time immediately following the inception of successful fire-protection, may never occur again unless a means of reproducing artificially a sufficiently close approximation to those conditions without undue damage to the standing crop can be discovered.

A somewhat similar condition of things in some of the teak forests in Burma may have given rise to what has been, perhaps somewhat gratuitously, referred to in the pages of the *Indian Forester* as the "'Burma School,' upholding as its device the motto that fire's are good for teak forests." But to one who has spent several years in certain classes of forest it does not seem to be an entirely unreasonable conception that there may be conditions in which fire might be usefully employed in facilitating regeneration and possibly also in assisting advance growth when the most valuable species happens to possess the highest fire-resisting capacity.

The enormous cost of and practical difficulties met with in endeavouring to carry out by hand such weedings and extermination of creepers as appear to be necessary to enable the young sal to win through over large areas in these mixed sal forests are circumstances which naturally tend to make a Divisional Officer look round for some other means of attaining his end, and he may be excused for refusing to believe that because fire has proved such a bad master it must also necessarily be an equally bad servant, and that the last word has been said on fire-protection in this connection.

THE EFFECTS OF THE GREAT FROSTS OF 1905 ON THE FORESTS OF NORTHERN INDIA.

VI.—THE EFFECTS OF THE FROST IN THE DECHAURI RANGE, KUMAUN, U. P.

BY GANGA NARAYAN DIKSHIT,

FOREST RANGER, KUMAUN DIVISION.

The severe frost of last winter was not alone fatal to the cereal crops, but it told upon the forest vegetation as well.

The following note was made upon the damage done to the trees which suffered in the Dechauri Range of the Kumaun Division :—

(1) As soon as the frost set in the foliage of Buchanania latifolia began to wither up, and as the frost became more intense the hardier species began to dry up, until not a single species save khair and sisso were left unaffected in the low-lying places and

valleys. Forests situated on higher levels and ridges of mountains were affected less because on these only young saplings and not poles and mature trees fell victims. When the dried foliage dropped from the trees at the commencement of the summer season, it made the forest like tinder and ready to catch fire even at the slightest accident. For this reason the fire-protection has been more intense this year, and the Rangers and Forest Guards had to be alert at their work of patrolling the forest.

Now that the rainy season has commenced a number of the injured trees have obtained new life and foliage, but still hundreds of trees show no signs of reviving, having been killed outright.

(2) Even the trees which have revived are retarded in their growth. This I found out by comparing the results of measurements of sample plots for this year with those of the previous years.

(3) The produce from honey has been much less. In localities from which maunds of honey were extracted in previous years hardly seers could be found there this year because, *firstly*, millions of bees died owing to the severe frost; secondly, the flowers out of which honey would have been extracted dried.

(4) The production of Rori (the red powder from the fruits of Mallotus Philippinensis) has suffered in the same way because the fruits on the trees dried and fell down.

(5) The export from myrabolans has been very small. The fruit of this tree suffered so heavily that even the monkeys found it hard to fill their stomachs with it.

Honey, Rori, and myrabolans are the important and valuable articles of export which pay back the contractors of Keranamal the price which they bid in auction. Hence these articles having been killed outright by the frost the contractors of Keranamal are heavy losers.

While marking in the different ranges of the Ganges Division during the whole of the winter season and while looking after the fire conservancy of Fatehpur Range in the Kumaun Division, I have been carefully noting these injurious effects of the frost on the forest vegetation.

14th August 1905.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES

A TREATMENT FOR HYDROPHOBIA.

I send you the following curious prescription for the treatment of hydrophobia I received from a native of India, or more particularly of the Deccan.

Firstly, clean and cauterise the bitten part; then keep the wound open by applying linseed poultices.

For *internal administration.*—Take a handful of green leaves of the wild babul (Hind. *Divana babul*, Telugu *Muki ahumab*), wash well and pound in a clean mortar. Add a sufficient quantity of water to produce, when strained through clean muslin, about a wine-glassful of juice. Dose for an adult one wine-glass; for a child, half this quantity of the strained juice.

Give for three days on an empty stomach in the morning and one hour before the evening meal.

Diet.—Sweet "tire" or curds (Hind. *chakka dhyn*) and rice or wheat cakes, prepared without fat, *i.e.*, ghi, or salt.

No stimulants whatsoever to be given during this period. If desired, weak tea may be allowed. If the patient is of nervous temperament and affected by cloudy weather repeat the dose as above for three days and diet as directed.

If on administering the decoction of the leaves the patient is apt to vomit, a tablespoon of sweet tire (chakka dhyn) will be found useful.

* * * * * *

I have not been able to find out which of the acacias goes by these names (Wild babul, Hind. *Divana babul*, Tel. *Muki ahumab*) and have referred to Brandis' and Kanji Lal's "Floras of the North-West Provinces and Oudh" and also to Cameron's "Forest Trees of Mysore and Coorg" without determining it. Could you, or any of your readers, should you think fit to insert this in your estimable monthly, give me the scientific name of this species?

My informant further told me that the pods are short and crooked and when dry are of a dark brown colour.

R. D. HUDSON.

EXTRACTS FROM OFFICIAL PAPERS.

FIRE PROTECTION IN MADRAS.

[The following papers on the subject of fire protection in the Madras Forests will, we think, prove of considerable interest to our readers.--Hon. Ed.]

Resolution—Forest No. 76, dated 24th March 1905.

(2) In March 1902 Mr. A. W. Lushington, District Forest Officer, North Coimbatore, in a long and strongly worded note to the Collector, brought to notice the terrible destruction of the forests in the division by annual fires which threatened the supply of water in the Cauvery. He pointed out the insufficiency of the sanctioned punitive measures as deterrents and the urgent need for taking energetic action in the matter. Sixty per cent of the fires in the North Coimbatore Division were ascribed by him to wilful incendiarism by graziers in order to obtain new grass, 30 per cent to the hill tribes (the Sholagars) for the purpose of enabling them to find out minor produce, and 10 per cent to carelessness of travellers and bandymen passing along cart-tracks, paths or streams in the jungle. In order to check these fires Mr. Lushington urged the entertainment of a larger establishment, the cutting and clearing of permanent fire lines so as to be easily convertible into cart-tracks and roads, and special legislation to fix responsibility on the ryots of villages within a radius of 20 miles of the scene of any fire. The Board, however, considered the suggestions of Mr. Lushington to be too vague, and called * on him to devise more practical measures of protection. The Board at the same time suggested that some attempt should be made to influence public opinion in the villages concerned and to secure the co-operation of the purchasers of minor forest produce and that of the local revenue officials in the matter.

3. Mr. Brasier, the late acting Conservator of Forests, Southern Circle, in submitting for orders a similar note by the

* Board's Proceedings, Forest Mis. No. 113, dated 9th March 1903.

District Forest Officer, Madura, urged that the hands of District Forest Officers should be strengthened by entrusting to them the powers of closure which had been delegated to the Board in Government Order No. 141, Revenue, dated 6th February 1902. In this opinion he was supported also by Mr. Cardew, then Collector of Madura. The Board, however, was not * then in favour of further delegating these powers; it held that the closure of forests to grazing was a drastic form of punishment and that the punishment of increasing the rates of grazing fees, suggested in the papers disposed of in Board's Proceedings, Forest No. 67, dated 9th March 1903, recorded in Government Order, No. 402, Revenue, dated 22nd April 1903, was perferable to total closure. In the meantime the Collector of Coimbatore (Mr. Bedford) made yet another suggestion. He pointed out that steps were being taken to divide the unwieldy forest reserves in North Coimbatore into compartments or grazing blocks of 3,000 to 5,000 acres in extent, and suggested that, whenever a compartment was fired, the permits for grazing therein should at once be cancelled and be only renewed on payment of double fees, the fees being again doubled each time a fire occurred in the block. In recommending this suggestion Mr. Bedford also proposed that power should be vested in the Collector himself to issue the necessary orders in the matter, a report being simultaneously submitted to the Board, as, in his opinion, speedy punishment had double the effect of a deferred punishment.

4. On a perusal of these reports the Board considered that the whole subject of fire protection and the most suitable penalties for incendiarism require further careful consideration, and, accordingly, requested the three Conservators to submit their views on the question after consulting the Collectors and District Forest Officers.

5. The views and suggestions of the various officers consulted as to the best means of preventing fires and punishing incendiaries are contained in the papers read above. The variety of the recommendations made is no doubt striking, but is not, in the Board's opinion, to be wondered at since the conditions of the problem vary greatly from district to district, and the measures to

* Board's Proceedings, Forest Mis. No. 212, dated 8th April 1903.

be adopted must depend on local conditions. The preventive measures suggested, which require notice, are enumerated below—

(*a*) to clear and fire trace all boundaries (both forest and district boundaries) a also all admitted rights of way and paths connecting camping grounds with each other or with villages outside the forest boundary;

(*b* to have a network of exterior and interior fire lines, to isolate or localise the fires and to open up the forests by paths and roads so as to admit of all paths being easily reached;

(*c*) to increase the number of fire patrols and employ them permanently throughout the year;

(*d*) to divide the forests into small, compact and manageable blocks, so that, when required, the areas may be closed effectively and without hardship to the people;

(*e*) to limit the felling and exploiting season to six months in order that the establishment may devote its full energies to fire protection during the dry season;

(*f*) to house the fire patrols in the forests themselves by providing them with huts on fire lines or on ridges commanding a view of the surrounding forests;

(*g*) to close special areas to grazing during hot weather and encourage haymaking in those areas;

(*h*) to empower the District Forest Officer to manage the grazing grounds on the same commercial principles as he regulates the sale of other produce;

(*i*) to prohibit the penning of cattle in the forests from 1st March to 1st September of ever year;

(*j*) to burn departmentally early in the fire season the most grassy parts of the reserves so as to offer graziers no inducement to burn the forests;

(*k*) to dispense with the system of having a few scattered fire patrols and to employ instead gangs of men in the larger interior forests and village watchers at the most important villages near the forests so that timely help can be obtained;

(*l*) to lease the pasture in each block to a responsible person with the stipulation that, on the occurrence of fires, the block will forthwith be closed, but that, in the event of the forest being successfully protected, the lease will be continued for a further term to the lessee.

The preventive measures (*j*) and (*k*) have been suggested by Mr. Hodgson, the District Forest Officer, Cuddapah: they meet with the Board's approval, and the Collector of the district has accordingly been authorised to give effect to them as an experimental measure. It may as well be realised at once that the Department cannot at present, and probably never will be able to, protect all the grassy scrub jungles from fire; their early burning under control, when the fire will do the least harm, seems, therefore, to the Board a sound principle; early grazing will then be provided and one of the greatest temptations to the graziers towards incendiarism will thus be removed, the protection of the

more valuable forests being thereby rendered easier. The prohibition against penning cattle in the forests during the hot weather item (i)—a proposal which has also emanated from Mr. Hodgson, will, no doubt, also lessen the danger of fire occurring. The rules and conditions regulating the issue of grazing permits approved in Government Order, No. 45, Revenue, dated 26th January 1897, prohibit the penning of cattle in reserved forests except with the special permission of the District Forest Officer. The absolute prohibition of penning under these orders might, in certain areas where the grazing grounds are distant from the boundaries of the reserves or from places outside the reserve suitable for penning, amount to forbidding grazing altogether, and the condition should not be enforced to bring about this effect. District Forest Officers should, in all such cases, obtain the sanction of the Collector before forbidding penning.

The proposal (*h*) regarding the management of grazing grounds is made by Messrs. P. M. Lushington and A. B. Jackson: the Board, however, entirely dissents from the view taken by these officers. Mr. Brasier's suggestion (*l*) to lease the pasture in each block to a responsible person may be found suitable in some localities, but it could only be introduced where the person to whom it was proposed to grant the lease possessed influence with the villagers and could be trusted to deal fairly with them; the existence of faction would make its adoption impossible.

6. Of the preventive measures suggested above, those based on such expedients as fire lines, the isolation of blocks and the employment of fire patrols are at present being carried out by Forests Officers as far as the means and the establishment at their disposal permit. It may, the Board considers, be anticipated that each year these measures will become more effective, and that in course of time the Forest Department may thus look forward to the damage from fires once started being confined to smaller areas.

7. It is, however, most important to try and devise measures which will really prevent fires being lighted. At present it is the immediate selfish interest of a large number of people who frequent the reserves to set fire to them. Graziers, shikaris

minor produce contractors, all rejoice to see the jungle burn. The detection of incendiarism is most difficult, and even with an enormously increased staff, the prosecution and punishment of offenders will never be an important factor in putting a stop to this class of crime. It is necessary to make those who frequent and dwell in the reserves realise that it will not be even for their immediate advantage to fire the forests. This can only be done by a system of rewards or punishments in which the whole community will partake.

It may be objected that punitive measures which fall upon the whole community involving the innocent with the guilty are unjust, but it is impossible to devise effective measures which will not be open to this criticism. Such measures at all events ensure that the persons likely to be affected will do their best to prevent the recurrence of the events which have inconvenienced them.

8. The most important punitive measures recommended to be adopted in cases of incendiarism are given below—

(1) Cancellation of all permits issued, whether for grazing or for other forest produce, in areas under special fire protection and charging full seigniorage rates for renewals.

(2) Immediate and absolute closure to grazing of the burnt areas and the adjoining forests if necessary.

(3) Raising the grazing fees in forests which have been burnt.

(4) Total exclusion of cattle from the forests in the year in which the block was burnt and the imposition of enhanced fees in the succeeding year.

(5) Issue of grazing permits with the proviso that they should automatically expire as soon as a fire occurred in the compartment and the imposition of a fresh grazing fee every time fire occurs without questioning its origin or inquiring if any attempt was made by the graziers to put it out, the fees paid for the fresh permits being refunded if, on subsequent inquiry, it is proved that the fire originated outside the compartment and that the graziers did their utmost to extinguish the same.

(6) Making every minor produce contract liable to cancellation in the event of the leased blocks being burnt.

(7) Raising the price of fuel in depôts and the price of permits for grass and fuel in villages adjoining forests where fire occurred.

(8) Withdrawing from the wargdars in South Canara their kumaki rights on the occurrence of fires.

(9) In cases where villages exist within reserves, making the villagers pay a punitive fee equal to not less than the actual annual cost of clearing the fire lines round the villages if in spite of these lines fires cross the forests.

The Board does not approve of the suggestion (5) made by Mr. Jackson or (8) and (9) made by the District Forest Officers of South Canara and Madura. Nor does the suggestion of Mr. Lodge contained in item (7), *viz.*, raising the price of fuel in depôts and the price of permits for grass and fuel, commend itself in its entirety to the Board. Every effort of the Department should, in the Board's opinion, be directed to make depôts popular so as to prevent as far as possible people going to the forests for unlawful purposes. Where, however, the fire could with reasonable certainty be traced to permit-holders, the punitive measures proposed would be certainly justifiable. As regards the other suggestions, it will be observed that there is a considerable conflict of opinion as to whether enhancement of fees or closure of the reserve to grazing is the most effective and suitable measure. The Board considers that it may be left to the local authorities to decide in each case whether suspected incendiarism in a reserve is to be punished by closure of the area or by the imposition of enhanced fees. The present Forest Member would, subject to the reservation mentioned below, generally prefer the punishment of closure to that of enhancement of grazing fees, as the former cuts more at the root of the evil by entirely preventing the offenders from gaining any advantage from their wrong-doing. Moreover, as pointed out by the District Forest Officer and the Collector of Tinnevelly, this method of punishment is less likely to conduce to corruption on the part of the subordinates by permitting the grazing of unlicensed cattle, since it is comparatively easy to detect illicit grazing when an area is entirely closed. At the same time the Board is of opinion that the punishment of closure should not in any case be worked so as to deprive cattle entirely of pasture, though it should, as observed by Mr. Brasier, always involve grave inconvenience to the graziers and owners, such as having to drive their cattle to remoter blocks and to take out perhaps fresh permits. Messrs. P. M. Lushington, Brasier, Bedford, and Buckley consider that the closure of a block without opening another area for the cattle to resort to would not result in the starvation of the cattle, and Mr. P. M. Lushington adds

that all valuable cattle could and would be kept alive by stall-feeding in a much better condition. The Board is, however, not prepared to recommend the adoption of any policy which would result in the practical starvation of the poorer cattle.

In cases where the punishment imposed takes the form of levy of enhanced fees, the Board considers that it is clearly necessary that the enhancement should be sufficiently substantial to make the offending villagers sensibly feel the penalty. As remarked by some of the officers consulted, the suggestion made by the District Forest Officer, Cuddapah, and approved in Board's Proceedings, Forest No. 67, dated 9th March 1903, to enhance the fee to the sanctioned maximum is not likely to be effective. The Board accordingly considers that the fee might be raised to double the sanctioned maximum as recommended by the Collectors of Kistna, Cuddapah, and Nellore, and by the Conservator of Forests, Northern Circle (Mr. Lodge): such an enhancement could not be regarded as prohibitive in view of the existing exceedingly low rates.

9. All the officers consulted lay emphasis on the fact that whatever punishment is imposed it should be promptly inflicted. The Board agrees with them, and requests accordingly that Government will be pleased to authorise Collectors to exercise the powers of closing the reserves or of enhancing the fees delegated to the Board in Government Orders, No. 141, Revenue, dated 6th February 1902, and No. 1092, Revenue, dated 2nd November 1903. It should, however, be at the same time provided that any such orders passed by Collectors should be reported at once to the Board for confirmation, and that Collectors should furnish with their reports information on the points noted in the margin and on such other points as may be necessary to enable the Board to form an opinion on the suitability of the punishment awarded. With this information before the Board it can always correct any unduly harsh orders of the Collector in good time. The Board also considers it most important that the orders passed

(1) Evidence that fire was due to incendiarism or culpable negligence.
(2) Action taken by villagers, graziers, etc., in putting out the fire.
(3) Reserves available in case area burnt is closed.
(4) State of the season and pasture available on unreserved and private lands.

by the Collector or whether in regard to closing the reserves or enhancing the grazing fees should, if possible, be preceded by an inquiry on the spot by a responsible officer, such as the District Forest Officer or his Assistant or the Divisional Officer, at which the persons likely to be affected should be present. These persons would in this way know exactly what they were punished for, and would not imagine, as they otherwise might, that the closure or the enhanced fee was merely a piece of extortion on the part of the Forest subordinates.

10. Mr. Brasier draws attention to the orders of the Bombay Government, No. 7136, dated 13th October 1903, which direct that villages in which fires have been frequent or extensive should be selected and the villagers should be assembled and formally warned by the mamlatdar or Range Forest Officer or, when possible, by the Divisional Forest Officer in person that a recurrence of similarly extensive fires will result in the deprivation of all privileges including grazing. A similar system of giving notice to villagers of the consequences that may ensue on the occurrence of a fire is in force in this Presidency also. The warning is conveyed in this Presidency by the publication of a notification in the forest sheet of the District 'Gazette;' and Collectors have further been instructed in Board's Proceedings, Forest No. 264, dated 29th July 1901, to take care that the terms of the notices are made known at frequent intervals to the residents of villages adjoining reserved forests The Board, however doubts whether these orders are given effect to in practice, and in reminding Collectors of them it considers that the jamabandi time affords a good opportunity for carrying them out. It is observed that the Bombay Government Order above referred to also gives powers to Collectors to suspend for the year following the fire all the privileges which the villagers concerned enjoy or such of them as the Collector may consider it advisable to suspend, the privileges being restored at the end of the year unless, on the report of the Divisional Forest Officer, the Collector sees fit to continue the punishment for another year; in this latter case the sanction of the Commissioner has to be obtained for the continuance of the punishment. The Board considers that the Collectors in this

Presidency should similarly obtain the sanction of the Board if the penalties imposed by them are to be continued beyond one year.

11. The Board would prefer not to rely exclusively on punishments for incendiarism and departmental precautions for restricting and extinguishing fires, for the protection of the reserves against fire, and considers that in certain cases rewards might be granted when the forests had been free from fire. The following suggestions have been made :—

(*a*) to grant rewards to each village headman or talayari in whose jurisdiction no fire occurred for five years;

(*b*) to levy a higher rate of grazing fees in fire-protected blocks so as to contribute towards the cost of protection, and if the block or blocks escaped fire during one season to reduce the rates for the next season, and so on; and

(*c*) to employ jungle tribes as fire patrols, paying them by results at the end, of the fire season.

As regards the proposal in item (*a*), *viz.*, to grant rewards for protecting the forests from fire, which is made by the Collectors of Ganjam, Vizagapatam, and Kurnool, and the Conservator of Forests, Northern Circle (Mr. Lodge), the Board agrees with the last-named officer in considering that the principle laid down in Government Order No. 31, Revenue, dated 15th January 1894, should be maintained, and that villagers, unless employed as regular fire patrols, should not receive any payment for extinguishing fires. The objection to rewards for extinguishing fires does not apply to rewards being given in cases where fires have been successfully kept out of forests for some years. In such cases they might take the form of lower grazing fees and lower rates of permits for fuel. Such rewards would only be appropriate in the case of forests which by their situation the villagers can practically control, and can properly be allowed the credit for their immunity from fire, such as for instance forests surrounded by or close to villages. In large mountain forests the co-operation of the jungle tribes is essential. A system of rewards paid to such tribes is reported to have succeeded well in Coorg. Where such tribes are employed in gathering minor produce for the department the Board considers that they may be given a reward in the shape of better prices for produce when there are no fires and punished by poorer prices when there are fires.

The results of the system introduced in the Upper Godavari of employing jungle tribes as fire patrols and of paying them by results at the end of the fire season (item *c*) have, the Board notes, been very satisfactory. It might be adopted in forests similarly circumstanced, *viz.*, where the population is comparatively homogeneous and the headmen have considerable influence.

12. In the last but one of the papers read above, the Conservator of Forests, Northern Circle, submits for the Board's orders the proposals made by Mr. Cox for fire protection in the Nallamalais. These proposals seem to the Board to be well thought out. The fires on the Nallamalais are ascribed mainly to the Chenchus; and the importance of securing their co-operation cannot therefore be overestimated. The Board notes that the local District Forest Officers are thoroughly alive to the situation and are doing what they can in the matter. The Board has called on Mr. Brasier to give the subject of fire protection his special attention during his visit to the Nallamalais, and expects to receive from him shortly a full report on the subject.

13. In conclusion the Board cannot too strongly emphasise the enormous importance of fire protection of reserved forests. The destruction that is reported to be going on in North Coimbatore and depicted by Mr. A. W. Lushington is taking place more or less in all the forest reserves of the Presidency. The statistics of forest fires recorded in the annual reports are, the Board fears, very misleading; it is an undeniable fact that nearly everywhere forests are being systematically burnt. The entire destruction of young growth particularly is appalling and the trees that survive are largely ruined. In many of the reserves valuable timber trees are rendered almost useless owing to heart-shakes, warping and other forms of deterioration brought about by fires; and the Forest Member found that in the Nallamalais many of the finest timber trees could in consequence only be disposed of as fuel for railways. It is thus clear that, if forest conservancy is to be of any real service, every effort of the department must be concentrated on making fire protection effective. At present it is to be feared that in many districts owing mainly to the annual destruction of

tree growth by fires the reserved forests so far from improving are not even maintaining their ground.

Fires are easily started in the Indian jungles in the hot weather, and the agencies by which they may be started are, as has been already explained, very numerous. The Board therefore considers it impossible ever to expect that fires will be totally kept out of forests; but by adopting those of the measures discussed above which local officers consider most suitable to the conditions of their districts, the Board hopes that great improvement can be effected and that a large proportion of the more valuable forests can be effectively protected. When working-plans for forest reserves are elaborated and completed, the Board hopes to have a clear policy of fire protection for each area dealt with, and it is expected that by that time there will also be available a larger and more capable staff than at present to carry out the policy prescribed in those plans.

(TRUE EXTRACT.)

(Signed) N. MACMICHAEL,
Acting Secretary.

ORDER—No. 554, Revenue, dated 14th June 1905.

FOREST No. 105.

In the Proceedings read above, the Board of Revenue deals with the several measures suggested for the protection of forests from fire. Subject to the remarks in the following paragraphs the Government agree generally in the views propounded by the Board.

2. In the selection of measures to prevent fire, it must be clearly recognised that the practice of burning grass is no new one, and that it is in fact necessary in order to improve grazing. The Government accordingly consider that the best way to deal with the problem is to control the burning rather than to attempt to stop it, and, where grazing is required, to burn under departmental management and supervision a sufficient area to meet the proper requirements of the graziers. This measure is reported to have been already introduced in the Cuddapah district, and the Government consider that it should be given general application.

3. When, in spite of this and other precautions, the illicit burning of forest areas occurs and can be attributed on reasonable grounds to the action of graziers, such conduct can be most suitably and effectively dealt with by closing the burnt areas to grazing, and so depriving the delinquents of the benefit they sought. The Government agree with the Board and the officers consulted by it that in such cases whatever action is taken must be taken promptly, and they accordingly approve of the proposal to authorise Collectors to exercise the power of closing the reserves subject to report to and confirmation by the Board as proposed in paragraph 9 of the Proceedings. No such penalty imposed by a Collector should continue beyond the year in which it is imposed without the distinct sanction of the Board.

4. The Government consider that it is not desirable to delegate to the Collectors the power of enhancing grazing fees, and that such a power should be exercised only by the Board of Revenue. In the opinion of His Excellency the Governor in Council this power should not be used except in very exceptional circumstances, and while refraining from entirely prohibiting the enhancement of grazing fees as a penalty, the Government desire that resort to this expedient should only be had as a last resource. Should it become necessary thus to enhance grazing fees, special notices explaining the reason of the enhancement should be published in the villages concerned, and the limit of enhancement will be to double the previously sanctioned maximum.

5. To prevent the burning caused by the contractors of minor forest produce, the contract should be made liable to cancellation in the event of the leased blocks being burnt. A condition to this effect should accordingly be inserted in all such contracts.

6. The Government approve of the proposals to grant rewards to each village headman or talayari in whose jurisdiction no fire has occurred for five years, and to employ jungle tribes as fire patrols, paying them by results at the end of the fire season. It should be the policy of the Forest Department to enlist the services of jungle tribes for every purpose for which they can conveniently be utilised and to get them under its control by

making them its paid servants; and it follows that whenever possible they should be employed as fire patrols. The third suggestion in paragraph 11 of the Board's Proceedings to levy higher grazing fees in fire-protected blocks does not appear to the Government to be sound in principle, and cannot be approved.

(TRUE EXTRACT.)

(Signed) A. G. CARDEW,

Ag. Secretary to Government.

ADVANTAGE OF CO-OPERATION BETWEEN THE GOVERNMENT AND LIVESTOCKS ASSOCIATION IN THE REGULATION AND CONTROL OF GRAZING IN FOREST RESERVES.

BY FRED P. JOHNSON, SECRETARY, NATIONAL LIVESTOCKS ASSOCIATION, UNITED STATES.

Assuming that it is conceded that the forest reserves may be used in an economical manner for the grazing of livestocks.

the absolute necessity of an efficient control and regulation of this privilege, for the protection of the reserves, must be admitted. To those not familiar with the vast areas the forest reserves cover the task of providing an efficient patrol to guard them and prevent their injury may seem a mere matter of detail. Those who are familiar with these conditions, on the contrary, are inclined to the belief that the whole United States Army would hardly furnish enough men to give the adequate protection needed. While, under the present system of patrol, a small army of men are in service, the protection afforded is only nominal. How then can the stockmen be allowed to graze in these reserves with the assurance that they will be rightly used, and not only the grazing but the forests as well be protected from misuse and vandalism, for there is vandalism in grazing as well as in the destruction of forests ?

From my knowledge of the stockmen in the West, I can assert that there is no class of men more vitally interested in sane and reasonable forest protection than the stockman. If given an opportunity, no class of men could furnish more absolute and reliable protection for these reserves. But would they do it ? Yes, if properly approached in the matter. The Western stockman is of a peculiar disposition, due probably to his environment. Restless and impatient under any attempt to bind him to iron-clad rules and regulations, yet, when approached with a request for help and assistance, even though he may derive no benefit, he is quick to respond.

It has been the failure of Governmental departments to understand this phase of his character that has resulted in much opposition to forest reserves. As the Pioneer, who braved the dangers and hardships of the frontier to open the way to civilisation, he has felt that he had acquired some moral rights which even the Government should respect, and to have a stranger ride up to him while on the range and dictate to him things that he may or may not do, even though spoken in the name of the Government, is galling to his pride and that feeling of absolute freedom which has been bred in his nature. Approached by the proper officials with an explanation of the necessity of the forest reserves, the good that will eventually result to him from their establishment, and a request

for assistance in maintaining them and carrying out the plans of the Government, would meet with immediate and hearty response.

All over the West there are organisations of stockmen who have associated themselves together for the protection of their interests and for the improvement of conditions in their industry. These organisations are composed of the leading and progressive stockmen in the various districts. These are men who are building homes in the desert, and they are profoundly interested in anything that affects the prosperity of their locality. Here already organised is an army of men greater than any the Government could press into service for this purpose, ready, willing, effective and to be had for the asking. The Government has only to request that, in return for the privileges of grazing on these reserves, the organised Stocks Association assume the tasks of protecting them, fostering the vegetation and preventing fire and vandalism. It is possible that many of them do not thoroughly understand the problem the Government has undertaken to solve; then they should be enlightened, and it would be found that there would be no more enthusiastic supporters of the reserves than the stockmen.

It must not be understood that I advocate the complete turning over of these reserves to the stock interests.

The Government control and supervision must be absolute, but the organised stockmen could be sworn in as Forest Officers. They should have at least an advisory voice in the making of the rules and regulations and in return should be given as much freedom in the use of the reserves for grazing purposes as would be consistent and in keeping with the objects to be attained.

The advantage of such co-operation between the Government and stockmen must be evident. The advantage to the Government is to enlist the active assistance of men who live on the ground, as it were, in the advancement of the forest reserve idea. Under such an arrangement the reserves would have a better protection than could possibly be obtained in any other way and at the minimum cost for administration.

Instead of the antagonism of a large class of citizens, who really have rights that the public is morally bound to respect, you

will have their enthusiastic support. This, in my mind, is worth much. On the other hand, the stockmen are made to realise that these reserves are being maintained for the benefit of the community in which they live, and they, having secured a personal interest in the success of the idea, will do their utmost to build up the reserves along the lines desired. While they are given the right to use the reserves for grazing purposes, the privilege will not be abused under such conditions, for the community being interested, will permit no abuse.

The time to inaugurate the proposed plan is at hand, since the reserves have passed into the control of the Department of Agriculture through the recent passage of a Bill by Congress transferring the administration of the reserves from the Department of the Interior. The Department of Agriculture is closer to the stockman than any other department of the Government, and now that the transfer is accomplished it will be an easy matter to secure this co-operation.

It is unnecessary in a paper of this kind to go into the details of a plan to secure this co-operation. It is a perfectly simple matter, and where there at present do not exist Livestocks Associations to take up this work, they would be quickly organised when it was understood that the Government was willing to recognise them and accept their assistance in the building up of the reserves and in the maintenance of their safety and integrity. As to the question of the wisdom of adopting the policy suggested, it seems to me that there can be no negative argument worth considering, none at least from those who understand the actual conditions in the West.

THE CULTIVATION OF JUTE IN MADRAS.—A proposal was mooted at the Agricultural Conference held at Pusa last cold weather to make experiments in growing jute in Madras. This suggestion was submitted to the Revenue Board, and it was agreed that a beginning should be made at the Samalkot farm. Jute is sown in Bengal in April, but it was pointed out by Mr. Barber that owing to the different climatic conditions it would not be necessary to sow until June at Samalkot. These sowings have been made,

and the result will be awaited with great interest. If successful it is proposed to start a separate jute farm either in the Godaveri or Kistna delta.

THE TIMBERS OF SAKHALIN.—The Moscow correspondent of the *Standard* says that Sakhalin, which has been captured by the Japanese, is heavily timbered throughout; no fewer than 28 varieties of woods employed in commerce are enumerated. It will be interesting to learn where the forests are situated and how much of the area under tree growth has been given back to the Russians.

REPORT OF THE CINCHONA PLANTATIONS IN THE NILGIRIS, MADRAS.—The Director's report on the Cinchona Plantations is an interesting and full one, and shows that the results attained during the year were most satisfactory. Extra work was thrown upon him and his staff owing to an alteration made in the system of selling quinine at post offices, the pice packets now consisting of seven grains instead of five. The restocking of the old plantations has been vigorously carried on, nearly three-quarters of a million of young plants raised from selected seed having been added to the nurseries. The intensive cultivation now carried on combined with the selection of the seed from high class trees only will, it is hoped, greatly increase the future productive powers of the plantations. The quantity of bark harvested was greatly in excess of that of the previous year. The outturn of quinine from 504,000 lbs. of bark worked up in the factory was 12,920 lbs. Bark purchased from private growers yielded 2·5 per cent of quinine against 3·3 in 1903-04, and estate bark yielded 2·5 per cent against 3·01; the latter consisted mainly of prunings and the bark of sickly trees, whilst the purchased bark is stated to have been of much poorer quality than usual. As a result the total cost per pound of manufactured quinine rose from Rs. 10-7-8 to Rs. 11-3-10·52. The quantities both of quinine and febrifuge sold to hospitals, Native States, etc., again increased, and there was a corresponding increase under the receipts.

MOSQUITOES IN SOUTH LANCASHIRE.—Mosquitoes are making their unwelcome appearance in various villages bordering

the Manchester Ship Canal between Accrington and Manchester. The pests are supposed to have been brought up the waterway in timber boats from foreign countries.

CATTLE MORTALITY IN MADRAS.—A properly equipped and strong veterinary establishment would seem to be required in the Madras Presidency in order to be able to successfully cope with the heavy mortality amongst cattle. For the quarter ending December 31st, 1904, we find there were 25,674 deaths. Of this no less than 9,701 deaths are attributed to unspecified diseases—a fact which speaks for itself. Four thousand three hundred and twenty-three deaths occurred from snake-bite and from the rapacity of wild animals. From the latter cause the number was the highest on record during the last five quarters, totalling 3,661. It is suggested that it may be worth while considering how this heavy loss can be averted or at least modified. The districts of Nellore, Ganjam, Kistna, Godaveri, and Kurnool were the worst, each reporting 2,000 deaths or a total of 12,117, which was nearly a half of the total loss in the Presidency. Cuddapah was close up with 1,709 deaths. If these six districts alone were taken in hand and a strong veterinary staff appointed, an immense benefit would accrue to the people, whilst, doubtless, veterinary science would learn much that is at present hidden in impenetrable darkness.

THE EXPEDITION TO THE INDIAN OCEAN.—Mr. Stanley Gardiner, the leader of the expedition for the exploration of the Indian Ocean between Ceylon and the Seychelles in H.M.S. "Skylark," wrote in a letter received recently at Home that the expedition leaving Colombo on May 8th was expected to arrive at Chagos Archipelago about May 20th, where it would work until July 15th, thence going to Mauritius and remaining there till August 15th. From Mauritius the "Skylark" will return to the Seychelles, remaining there between September 8th and 15th. From the Seychelles the various Amirante Islands will be visited, the return to the Seychelles being made about October 15th.

SCIENTIFIC PAPERS.

SOME INDIAN FOREST FUNGI

BY E. J. BUTLER, M. B., F. L. S.

CRYPTOGAMIC BOTANIST TO THE GOVERNMENT OF INDIA.

PART III.

PERIDERMIUM THOMSONI BERK. AND BARCLAYELLA DEFORMANS DIET.

A fungus attack, of which two forms were found on the Himalayan spruce Picea Morinda (Abies Smithiana), was described by Barclay in the *Journal of the Asiatic Society of Bengal* in 1886. The name Æcidium (Peridermium) Thomsoni was given to the fungus on the assumption of its identity with a species found in Sikkim by Hooker and described in the *Gardener's Chronicle* in 1852 The first of the forms described by Barclay had been previously referred to Peridermium acicolum by Cooke from specimens received from Dalhousie, in 1877. The same author received the second form from Mahasu, Simla, about the same time and referred it to P. Thomsoni (*Indian Forester*, Vol. III, p. 88). Both forms were, however, as above mentioned, taken by Barclay as stages of the one fungus, Peridermium Thomsoni, the first as the æcidial and the second as the uredo stage. Later on Professor Dietel, to whom specimens were sent, found that the latter was really a teleuto form, and referred it to a new genus Barclayella, of which it is the type and only known species. This view was accepted by Barclay, and the genetic connection of the two forms was left doubtful awaiting experimental investigation which has not been attempted so far.

It is common in the Himalaya from Mussoorie to Simla, and probably as far west as the Kurram valley of the Afghanistan frontier. I have received specimens at different times from Messrs. Oliver and MacIntosh, of the Imperial Forest Service, from Jaunsar.

The æcidial stage (Peridermium Thomsoni) as described by Barclay is conspicuous on account of its colour and of the drooping habit assumed by the affected shoots. Every needle of certain shoots is attacked, and instead of standing out stiffly from the stem they lie close together embracing it. Shoots of the current season's growth only appear to show it. Those attacked are usually considerably longer than the unaffected. Both stem and needles are yellow in colour and the older specimens are much thickened and curved.

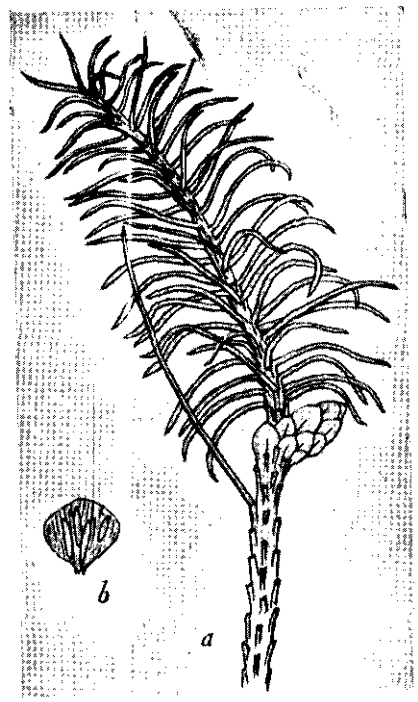


FIG 6.—BARCLAYELLA DEFORMANS ON THE SPRUCE.

Spermagonia appear towards the tip of the needles as little dark points uniformly distributed on the surface. The Æcidia are produced at a later period in two rows on the upper surface of the needles. At first they are pale red, but later on are reddish orange. They are long flat bodies formed by a colourless transparent membrane, containing æcidiospores.

The Barclayella is much commoner than the Peridermium, and is the only form which I have seen. A greater amount of deformity is produced on the affected shoots which, as before, appear to be always of the current year's growth. They are stunted, thickened and densely covered with curved needles, having at a distance an orange-red colour. Instead of forming two rows of isolated prominent spore-cases the teleutospores occupy two continuous flattened beds on the upper surface and two rows of smaller ones below. When young the whole emits a disagreeable odour.

One of the specimens sent me by Mr. MacIntosh in 1904 showed this form on the cones, in which position it has not previously been mentioned. The scales were attacked and some of them were deformed and stood out from the cone. Others

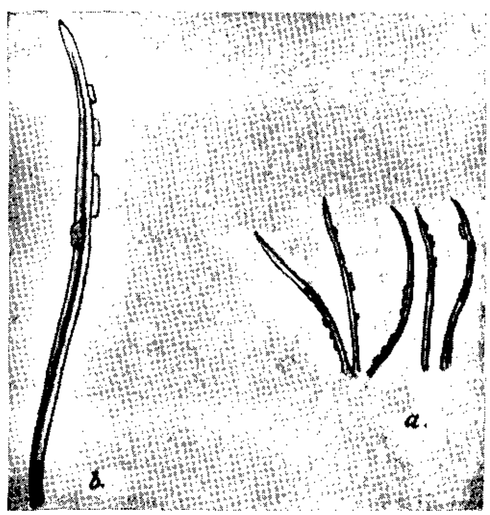


FIG. 7.—PERIDERMIUM PICEAE ON THE SPRUCE—a NATURAL SIZE; b MAGNIFIED THREE TIMES.

such as that shown in the figure were unaltered in shape. The teleuto beds occurred on the dorsal (outer) surface of the scale in one or more raised reddish bands.

PERIDERMIUM PICEÆ BARCLAY.

The Himalayan spruce bears yet another rust, which I have received from Mr. Oliver from Jaunsar. This is the Peridermium piceæ described by Barclay.

The æcidial (Peridermium) stage alone is known. It appears as long narrow spore-cases arranged along the upper surface of the affected needles somewhat irregularly and not in two rows as in Peridermium Thomsoni. The needles are turned yellow, and, as before, terminal shoots of the current year's growth are attacked. There is little deformity produced, but the presence of the parasite is revealed even at a distance by the orange-yellow patches scattered throughout the tree.

Mr. Oliver informed me that he had seen trees in Chakrata Cantonment in 1902 dying or dead from the effects of this fungus. This was due to the loss of all infected needles in 1901, when the attack was very severe. The trees were so weakened in consequence that they were unable to make new shoots or only put out feeble ones. None of the conifer rusts in the Himalaya have been hitherto described causing such damage as this.

PERIDERMIUM COMPLANATUM BARCLAY

I have received this species on *Pinus longifolia* from Simla, where it was described by Barclay, from Mr. Wroughton, I. F. S., and also from Palampur in the Kangra Valley collected by Mr. I. H. Burkill.

It resembles that last described except that the spore-cases are larger and are usually on the lateral or under surfaces of the needles. The attacked parts of the latter lose their colour, but the general effect of the fungus on the health of the tree appears to be slight. In Simla Barclay noticed that two crops are usually borne, one in November and the other, much more abundant, from February on to May. The former usually has spermagonia scattered irregularly over the surface of the needles while the latter has none.

A form (var. corticola) also occurs on the bark, where it does more harm than on the needles.

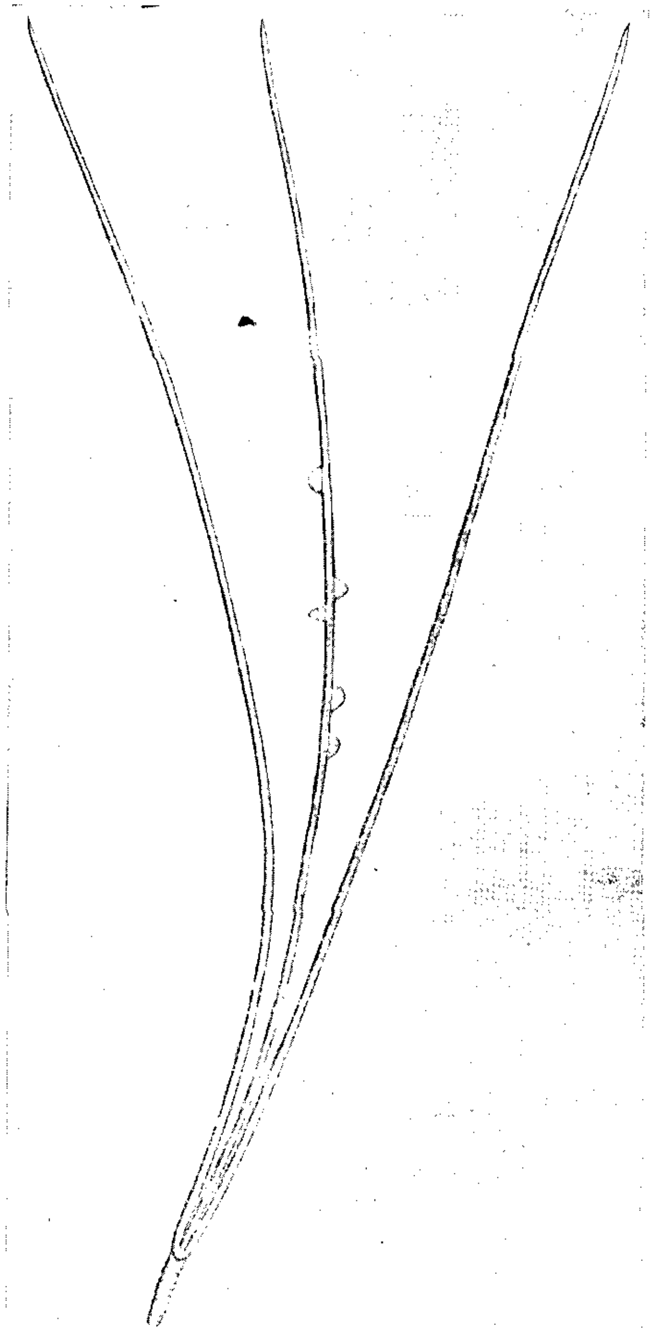


FIG. 8—PERIDERMIUM COMPLANATUM ON PINUS LONGIFOLIA.

PERIDERMIUM BREVIUS BARCLAY.

This rust occurs commonly on Pinus excelsa in the same region as the last. It begins to appear according to Barclay about April in Simla, only one crop being produced. On the whole it resembles Peridermium complanatum, but the spore-cases are distinctly smaller. I have received it from Jaunsar.

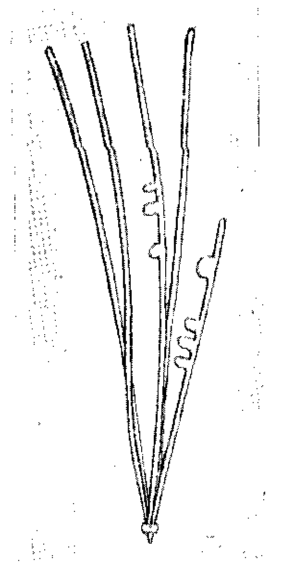


FIG. 6 —PERIDERMIUM BREVIUS ON PINUS EXCELSA.

PERIDERMIUM CEDRI BARCLAY.

A rare Æcidial form was found in 1884 on deodar in the Sutlej Valley, where a severe attack was observed on a few trees. Some needles only of each rosette were affected and curved downward. Numerous small Æcidia burst out on the upper surface without any accompanying discolouration. I have not seen this species.

PERIDERMIUM EPHEDRÆ COOKE.

I have received this species on Ephedra vulgaris collected in Karamba, Jaunsar, by Mr. Hole, I. F. S., in May, 1904. It is the only known member of the genus outside the Coniferæ

The young shoots and leaves are attacked, the former bearing Æcidia and the latter numerous very prominent

spermagonia. Considerable thickening of the shoots occurs, and from the specimens received it appears as if the number of these is augmented and a sort of witch's broom deformity of the attacked branch induced.

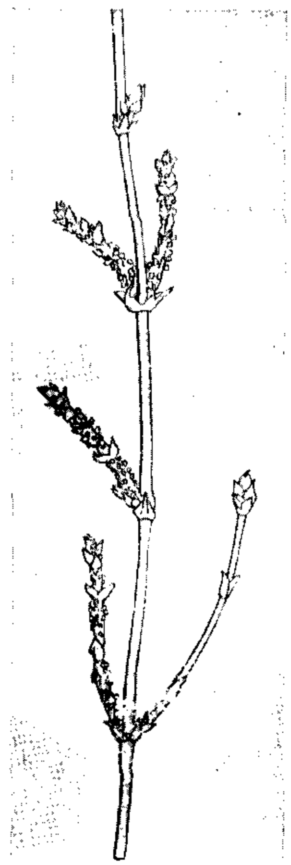


FIG. 10. PERIDERMIUM EPHEDRÆ ON EPHEDRA VULGARIS.

The Æcidia appear all round the shoot as more or less cylindrical or bladder-like spore-cases containing orange-yellow spores. As in the case of the other Peridermia mentioned, no further stage is known. The species has previously been recorded on Ephedra antisiphylitica and californica from California and Texas.

(*To be continued.*)

ORIGINAL ARTICLES.

THE TEAK TIMBER TRADE OF BURMA.

BY T. A. HAUXWELL, CONSERVATOR OF FORESTS NORTHERN CIRCLE, UPPER BURMA.

1. For the past two years or more the state of the Timber Trade in Burma has been viewed with alarm both by Government and by the mercantile community engaged therein, and grave apprehension has been openly expressed as to whether the diminished supply and high prices ruling would not only lead to the substitution of other woods, but that they might ultimately result in Burma totally losing the position it has held up to the present as the main supplier of teak for the whole world.

2. That this alarm is well founded is proved by the attempts lately made to substitute not only teak from Java but jharrah from Australia, both of which have come largely to the front, and although it is now found that the former is more brittle than Burma teak it is proved that both these woods can be used in lieu of teak for many purposes for which the latter was formerly solely in demand.

3. It is first necessary to see how this state of affairs has arisen, and the following table gives the details of the imports into the Europe market for the last 16 years :—

Imports of Teak into Europe from Burma and Siam.—Consumption, Stocks and Ruling Price.

Years.	From Burma (Squares).	From Siam (Squares).	Conversions. Tons.	Conversions. Per cent.	Total Squares and Convsns.	Deliveries into Consumption.	Stocks 31st December.	Ruling Price. Cargo Timber (floaters).	Ruling Price. Planks.
	Tons.	Tons.			Tons.	Tons.	Tons.		
1904 ...	18,047	6,381	21,114	46·36	45,542	55,152	17,114	£ 14 to 15	£ 14 to 16
1903 ...	20,206	5,697	20,341	45·67	64,244	55,287	26,721	„ 14 „ 15	„ 15 „ 16¾
1902 ...	17,193	9,059	29,231	52·08	55,483	67,511	17,767	„ 12 „ 13	„ 14 „ 15
1901 ...	16,869	6,912	26,324	52·54	50,105	63,870	20,795	„ 12 „ 13	„ 12 „ 14½
1900 ...	38,291	8,323	31,064	40·45	78,278	69,349	43,560	„ 12 „ 13	„ 12/10 to 14½
1899 ...	32,841	8,995	26,254	38·56	68,090	78,632	34,031	„ 13 „ 13½	„ 13½ to 14½
1898 ...	41,857	12,402	22,829	29·62	77,088	83,241	45,173	„ 12/10 to 13	„ 13 „ 14
1897 ..	38,884	19,821	20,124	25·53	78,829	70,139	51,326	„ 12 to 12/10	„ 12/10 to 13
1896 ...	33,358	20,328	13,073	19·58	60,759	78,344	42,636	„ 11 „ 12	„ 12 to 12½
1895 ...	39,260	20,275	11,284	15·93	70,819	55,511	54,221	„ 9	„ 9/10 to 11
1894 ...	35,051	7,098	8,773	16·93	51,822	50,181	38,013	„ 9/10	„ 10 to 11
1893 ...	28,067	1,942	7,579	19·70	38,488	48,745	37,272	„ 9/10	„ 10 „ 12½
1892 ...	32,167	5,488	6,689	15·09	44,344	43,543	47,520	„ 10/5	„ 10 „ 12
1891 ...	34,632	14,460	6,913	12·35	56,005	56,954	46,728	„ 10	„ 10 „ 12
1890 ...	44,904	24,079	4,837	6·54	73,910	69,946	47,677	„ 11	„ 10/10
1889 ...	54,450	11,434	4,345	6·19	70,229	59,224	43,713	...	...

4. From this we see (first) that imports into Europe have decreased from 54,500 tons to 18,000. Secondly, that prices have risen from £11 to £14 to 15 (and are still rising, having touched £19 in June 1905); and (thirdly) what is most important, that the imports of converted timber in the form of planks have steadily risen from 6 per cent to 46 per cent of the total exports, showing the decrease in first class squares; and (fourthly) that home stocks have diminished by more than 100 per cent.

5. It will be seen from the above that from 1889 to 1895 the home market was remarkably steady, and that it was from 1896 onwards that prices commenced to rise seriously, due to increased demand, and continued so to 1901-02, but the enhancement in price was up to this date to a certain extent controlled by increased supplies from previously accumulated stocks, but these becoming depleted and the output by lessees dropping suddenly from 151,000 tons to 77,000 tons in 1901-02 home prices then went up by leaps and bounds, till at the present moment they touch £19 per ton.

6. Added to this there is a downward tendency in the exports to India, which in 1898 were 144,000 tons and in 1904 only 106,000 tons. This is said to be due to competition from Siam and Java and also to large quantities of lessees' timber (undersized and refuse) being unfit for the Indian market even and which have to be disposed of in the round in Rangoon to prevent the accumulation of unwieldy stocks of inferior quality.

7. From the subjoined table of exports from Burma and Siam some further very interesting facts are apparent :—

Exports of Teak from Burma and Siam.

Years.	To Europe.			To India, &c. (Ports other than Europe.)			Grand Total.		
	From Burma.	From Siam.	Total.	From Burma.	From Siam.	Total.	From Burma.	From Siam.	Total.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
1904	34,692	16,691	51,383	106,404	61,617	168,021	141,096	78,308	219,404
1903	60,955	9,551	70,506	116,219	51,202	167,421	177,174	60,753	237,927
1902	36,387	10,111	46,498	112,079	47,343	159,422	148,466	57,454	205,920
1901	43,586	13,157	56,743	128,308	37,251	165,559	171,894	50,408	222,302
1900	59,212	11,182	70,394	138,371	27,150	165,521	197,583	38,332	235,915
1899	58,424	11,069	69,493	140,589	28,442	169,031	199,013	39,511	238,524
1898	59,318	8,850	68,177	144,752	17,636	162,388	204,070	26,495	230,565
1897	72,500	17,820	90,320	134,236	26,351	160,587	206,736	44,171	250,907
1896	45,711	18,835	64,546	135,665	28,625	164,290	181,376	47,460	228,836
1895	52,954	24,775	77,729	146,688	36,995	183,683	199,642	61,770	261,412
1894	48,176	13,077	61,253	138,509	24,105	162,614	186,685	37,182	223,867
1893	35,615	5,650	41,265	121,933	17,684	139,617	157,548	23,334	180,882
1892	50,276	2,650	52,926	125,295	10,880	136,175	175,571	13,530	189,101
1891	41,465	5,500	46,965	126,098	9,163	135,261	167,563	14,663	182,226
1890	36,657	19,600	56,257	135,852	13,470	149,322	172,509	33,070	205,579
1889	67,783	24,410	92,193	113,857	13,862	127,719	181,040	38,272	219,912

8. From this we see the steady advance of Siamese teak on the Indian market; the exports to India being—

			Burma Teak.	Siam Teak.
			Tons.	Tons.
In 1894	...	...	138,000	24,000
In 1904	...	...	106,000	61,000

which is considerably detrimental to Burma.

9. Further, this statement seems to show that the present ruling high prices are mainly due to increase *in demand* as the total exports from Burma and Siam have hardly varied as a whole, being 219,912 tons in 1889 and 219,404 tons in 1904, a difference of only some 500 tons but, whereas in 1889 Burma exported 181,000 tons against 38,000 tons from Siam, in 1904 the Burma exports were only 141,000 tons against Siam's 78,000; and while in 1889 of the total exports of 219,000 tons 92,000 tons went to Europe in 1904 only 51,000 tons could be supplied for that market, and it is noticeable that while from 1898 Siamese exports have gradually and permanently risen from 26,000 to 88,000 tons, Burma exports have decreased as gradually from 203,000 to 141,000 tons, and this placement is now threatened still more by the supply from Java.

10. What causes have led to this decrease of supplies and consequently to the high prices prevailing?

11. First and foremost the diminution in the supply of old girdled timber of large size. In former times this was available both in Upper and Lower Burma, and with unrestricted workings and the belief that the supply was unlimited was quickly made available. As the figures show, under controlled working the supply has been enormously curtailed, while the standard demanded has never been reduced. With the old original stock removed and the introduction of working plans by which the age of maturity of a teak tree is fixed on its reaching a girth of 7 feet the supply of Europe timber of first quality must be small. It is true that many working plans lay down that in certain localities, from which extraction is easy, trees may be allowed to remain to attain a larger girth; but so far this has not been laid

down as a prescription and I am afraid with the existing pressure of other work is more often than not overlooked.

12. In addition, although the reservation of teak-bearing areas has proceeded apace, girdling operations in these have been withheld as much as possible pending the preparation of working plans. As until these are compiled their capabilities are entirely unknown, and naturally the material in most cases derived from unreserved areas is of inferior quality.

13. Another factor in the case is the increased cost of working, due, among others, to the following causes :—

(I) Having to work in less accessible areas. It must be remembered that Burma is essentially a country of waterways, and the extraction of teak has always been mainly effected by this means. In former times the trees were felled and logged in the forests, chiefly in the neighbourhood of the main floating streams, a short drag was only necessary to get them there, and they were then allowed to float out with little assistance on successive rises, to the main river, often taking three or four years to do so, and then were rafted to the main centre. As time went on material was only found further afield necessitating often many miles of drag to a floating stream and in suitable localities cart transport, both ordinary and on special carts dragged by elephants necessitating the making of roads, was introduced while recently use has been made of a traction engine but this is only possible in very few places.

(II) The increase in the cost of elephants without which work could not proceed. The price of these has increased over 100 per cent., tuskers averaging some Rs. 4,500 each while good dragging females cost Rs. 3,000 to Rs. 3,500. Seeing that some 1,600 to 1,700 elephants are employed at present by lessees the increased cost of working under this head alone is very considerable, which is further accentuated by the percentage of casualties brought on by overwork necessitated by short leases not allowing of the full advantage being taken of unaided extraction by water; in addition to which the animals have to be employed longer into the dry season than formerly to ensure the timber reaching the streams in time.

(III) Increased rate of royalty demanded. Since 1890 rates have risen from Rs. 10 per ton for full-sized and Rs. 6 per ton for under-sized to Rs. 25 and Rs. 8 respectively, while recently as much as Rs. 35 per ton has been paid for special girdlings estimated to yield a higher proportion of Europe squares.

(IV) More rigid prescriptions as regards working. In former days undoubtedly the best was taken and the inferior stuff left, but now under the contracts all marketable material is bound to be brought out and royalty paid on it, and we know that under-sized refuse logs alone amount to about 22 per cent of the total outturn, and as this is only suitable for the local market a very large proportion of the expenditure incurred must fall on the better class of timber, more especially that of Europe quality which is a very small percentage. This, however, is a great point in favour of working by lessees, as after they have done working in a forest nothing is left but small stuff only suitable for conversion on the spot into "cart wheel pieces" or charcoal, whereas in departmental working it is often necessary to arrange for the removal of a large amount of material, fit only for the local market, after the first class girdled timber has been removed.

14. As a set off against the above it has been urged that lessees have been able to make considerable retrenchments by reducing both their staff and the salaries paid them and also by the abolition of bonuses. The last it is true in many cases have been abolished, and I can only suggest that some *quid pro quo* has been substituted; but I am not of opinion that in comparison with the output staffs have been reduced or salaries either. So far as my experience goes the standard of the staff has been considerably improved due to the necessity of keeping greater control over the workings and to this staff being brought closer into contact with Government officials, and this I should imagine would require corresponding salaries being offered.

15. Royalty rates under purchase contracts have also been forced up here in the same way and for the same reason as prices at Government auctions. Firms in competition and non-working exporters in the hopes of getting a footing have, so to

speak, gambled in the business, while others to keep their position there have not only had to pay heavily but have had also to organise business of the same kind in those countries from which the supplies of other material are taking the place of Burma teak in the fear of business in this Province alone not being sufficiently remunerative.

16. Also the area open to exploitation has annually increased by the opening up of unknown and less accessible areas but as already mentioned, until working plans have been prepared these cannot be exploited to their full possibility, and further supplies of first class material are only slowly coming forward. It is true that new markets in different parts of the world are also opening up, *viz.*, South Africa, Japan, etc., and increased activity in naval construction is universal, but at the same time even there teak timber is not in such demand as formerly and the high standard of quality demanded has never for one moment been lowered. In this Province and in India the demand for teak for local use has undoubtedly increased, but in very many cases it has been sold at a merely marginal profit to prevent the accumulation of enormous stocks and also to prevent teak from elsewhere obtaining a footing, and here also the slight increase in price has led to the substitution of inferior woods.

17. Let us now examine the system of working in Burma. This may be divided under three heads—

(I) Extraction by Government agency, by which the material brought to market is put up to public auction.

(II) Extraction by lessees or really holders of purchase contracts who pay a fixed royalty according to size and quality on all timber extracted which then becomes their own private property.

(III) Extraction by licensees.

The material extracted under this last system is entirely utilised locally and for the purposes of this article need not be taken into account.

18. The subjoined table shows the total output of teak in Burma from all sources during the past 16 years :—

Statement showing the total output of Teak in Burma taken from Forest Administration Reports.

Years.		Extracted by Government agency.	Corporation as per Duty Statement.	Darwood.	Macgregor.	Steels.	Foucar.	Burmese, Natives, &c.					Free Grants.	Total output Burma tons.	Total output of Foreign Timber in Moulmein logs.
								Walker and U. Kawi.	Hadjee Mohomed Hady.	Mg. Mun Taw & Mg. Bauk.	Purchasers Local Traders Sawbwas.	Total.			
1887-88	...	39,873	39,359	...	...	...	...	1,079	...	2,706	37,124	40,909	569	120,710	118,058
1888-89	...	55,183	87,325	...	...	..	...	412	...	8,468	43,805	52,685	213	195,406	135,755
1889-90	...	62,992	132,494	...	...	...		266	3,110	6,592	54,254	64,522	66	260,074	123,622
1890-91	..	42,012	107,665		...	...	...	1,189	4,601	..	66,483	72,273	197	222,147	116,322
1891-92	..	50,763	67,702	1,256	...	...		973	458	...	51,089	52,520	3,573	175,814	84,278
1892-93	..	54,596	120,474	7,931	21,806	...	...	664	4,950	...	67,041	72,655	10,983	288,445	118,592
1893-94	...	52,002	150,794	5,834	18,582	...	...	1,796	4,761	...	17,281	23,838	5,937	*256,988	134,811
1894-95		45,078	132,474	10,453	13,369	...	..	...	4,543	...	32,848	37,391	5,881	244,616	125,881
1895-96	...	53,519	141,370	4,124	18,970	...	...	...	860	..	35,647	36,507	5,554	260,044	97,524
1896-97	...	63,709	152,841	10,347	13,798	...	..	...	4,349	...	27,566	31,915	3,743	276,353	137,889
1897-98	...	64,136	220,486	8,588	25,998	...	...	...	,391	...	23,582	25,973	4,541	349,722	122,670
1898-99	...	73,375	168,913	13,100	11,932	2,727	658	...	2,342		21,486	23,828	3,366	297,959	131,310
1899-00	...	59,150	136,608	21,002	20,542	3,115	523	...	...	...	26,975	26,975	5,449	273,424	115,660
1900-01	...	51,856	117,666	10,760	15,463	6,382	963	...	...	...	36,676	36,676	5,019	244,785	154,341
1901-02	..	60,333	39,763	14,714	14,236	7,670	575	...	...	...	28,798	28,798	3,900	169,989	92,914
1902-03	.	60,479	47,785	14,284	8,940	10,910	1,263	...	...	...	19,749	19,749	3,261	166,671	122,318
1903-04	...	100,959	62,913	11,964	21,691	7,209	826	...	...	...	28,376	28,376	2,615	235,953	103,351

* Excluding 15,808 tons lapsed drift.

19. From this we obtain the following information :—

	Government outturn.	Lessees.
	Tons.	Tons.
1888—1896 ...	... 416,145	1,086,567
1897—1904 ...	... 533,297	1,235,757
	950,142	2,322,324

therefrom

Increase in Government supplies ...	... 117,852
Do. Lessees " ...	... 149,190

but as regards the latter the increase during the second period is more apparent than real as is shown by the following figures :—

	Tons.
Average outturn by lessees during 1896 to 1901	194,323
Actuals during 1901-02	76,958
Do. 1902-03	83,182
Do. 1903-04	104,003

the heavy drop in 1901-02 being due to the lapsing of the Pyinmana purchase contracts which were continued by the British Government at a very low rate of royalty after the taking of Upper Burma.

20. As will be seen there has been very little fluctuation in the imports of teak into Moulmein from Siam averaging 119,000 tons annually, and consequently these figures also need not be taken into account.

21. The increase under the head of extraction by Government agency is due to the increased area brought under regular working plans, while the decrease in the output by lessees is primarily due, as mentioned above, to the leases of the Pyinmana forest having lapsed and also to supplies of girdled timber falling short pending the preparation of working plans and to working having to be carried on in less accessible areas.

22. Having now seen the quantity of material available let us consider the financial position.

On account of timber extracted by Government agency and put up to public auction the ruling rates have been as follows :—

Average cube of Government logs sold and rates realised at public auctions at Rangoon :—

During		C. ft per log.	Average. Rate per ton. Rs. a. p.			Rate per log. Rs. a. p.		
1903-04	...	... 71·18	76	0	0	108	3	0
1902-03	...	... 71·47	75	7	0	107	3	0
1901-02	...	... 62·57	61	1	0	76	7	0
1900-01	...	... 65·50	63	6	0	83	6	0
1899-00	...	... 64·06	63	8	0	81	6	0
1898-99	...	... 60·31	66	15	0	80	12	0
1897-98	...	... 52·26	64	11	0	67	9	0
1896-97	...	... 61·04	68	15	0	84	2	0
1895-96	...	... 64·15	46	15	0	60	3	0
1894-95	...	... 60·39	47	5	0	57	2	0
1893-94	...	... 58·59	49	9	0	58	1	0
1892-93	...	... 52·27	47	0	0	49	2	0
1891-92	...	... 47·88	53	4	0	51	0	0

and of this timber not 20 per cent is considered capable of yielding Europe squares, while of the quantity extracted by lessees the percentage is estimated at not more than 10 per cent at the outside.

23. Here the prices to be paid have been forced up by competition. In the first place no lessee can afford to allow a competing lessee to obtain timber at a public auction for less than the former can work it out himself. Non-working exporters are forced to pay high prices to obtain anything and to hamper existing lessees. All are interested in procuring as much timber calculated to yield Europe quality as possible, while outsiders bid heavily to endeavour to obtain a footing which has to be prevented by existing lessees paying more, and in many cases shippers are forced to buy at the time to make up their averages on consignment. Considering the loss on conversion estimated

On Europe squares at 25 per cent
„ Indian „ „ 10 „
On timber for local use 25 „

it is easy to calculate what the selling price of the converted material must be to give a decent profit.

24. The cost of working by *so-called Government Agency*, which consists in paying a contractor a fixed rate per cubic foot

for an average sized log and paying or deducting a small additional rate per cubic foot over or under this size in order to encourage the bringing out of large-sized logs, varies from Rs. 14 to Rs. 24 per ton for delivery at a shipping port and may be taken fairly accurately at Rs. 19 per ton all round so that selling at Rs. 76 seems to leave a very large margin of profit, but if a percentage for establishment, supervision, etc., as calculated for a private concern were added this profit would be considerably reduced.

25. We have now to see what can be done to remedy the present state of affairs and whether Government can do anything to render the market more stable; and the question that has to be asked is, "Is Government in the Forest Department as a Semi-Commercial Department going to be content with a fair average royalty on its produce as a perpetual investment or will it, with a view to making a larger profit for some years, risk the possible loss of the trade in question?" In connection with the high rates lately paid for certain timber made available the argument put forward for demanding or forcing them is that "the market value of anything is the price it will fetch in the open markets." This I allow, but only to a certain extent, and not in the present case, where other considerations have to be taken into account; whether rightly or wrongly the payment of high rates of royalty and heavy prices at auction will naturally be quoted as a set off against prices being forced up in the home market.

26. Competition we must have, but competition between private individuals among themselves and competition between these and Government are two entirely different matters. The latter has unlimited finances, the former not, and while Government is in the position of a competitor I am convinced that it can do little, while if the business is left entirely to private individuals their individuality alone must help to settle matters. Mind, Government must still maintain a controlling hand with a view to preventing what in America is termed a "corner" both as regards foreign and local supply, but beyond that I am of opinion that provided it safeguards its own interests private concerns can be left to look after themselves.

27. On the other hand one asks if the profits made by the Government on timber extracted by its own agents are so large why does not Government undertake the whole of the extraction and sell all extracted material to the timber traders in the open market? *Because it cannot.* It has not the staff nor the working power, and lessees have been too long in existence, being an acknowledged legacy of Burmese rule. Business organisations have been built up at enormous cost and trouble, and are intimately connected with the interior development of the country, and the withdrawal of the largely invested capital would undoubtedly affect its prosperity; as it must not for one moment be imagined that the stopping of the purchase contract system would result in the working power being thrown into the hands of Government. The major portion would be transferred for similar work elsewhere, and in all probability a very large amount of invested capital in other directions would also disappear and a very large number of the inhabitants be thrown out of work, many of whom would be unfitted for any other occupation.

28. What appears to be the case at present is that Government has created a monopoly which has forced prices to an extreme limit, a state of affairs that *under existing circumstances it* seems powerless to alter.

29. The following extract from a recent paper seems peculiarly appropriate :—

"The idea that low or uncertain prices are in any sense or degree a source of advantage to anybody in the long run has been abandoned by thoughtful economists and traders. What any branch of the trade must have to be steadily profitable is stability. What the body politic must have to be prosperous is profit, and neither of these factors is attainable in the presence of declining or even sharply fluctuating values."

30. Two grounds for complaint are put forward by lessees concerned in existing purchase contracts as having an adverse influence on economical working, *viz.*—

(1) The short period for which these purchase contracts are granted and the non-guarantee of renewal, both of which are

undoubtedly well founded. The longest period for which existing purchase contracts run is 10 years, *viz.*, 1901 to 1910, while others were only issued in 1905, to expire also in 1910. In the latter case it is manifest that full advantage cannot be taken of the natural method of extraction by water. The fear of forfeiture of unextracted logs and fines for non-extraction necessitate this being assisted by carting and other means, and as the former is only practicable in favourable localities during the hot season the strain on animals is great and casualties heavy; while (11) the non-guarantee of continuous work militates against expenditure on permanent improvements both of roads and watercourses which might also under the existing system be of more ultimate benefit to a competitor. In another way also a guarantee, under suitable conditions of course, would be beneficial in that a fore-knowledge of it or of other areas likely to be thrown open would allow of the gradual organisation of the establishment and power necessary to work it, while at present this has to be hurriedly collected and at the termination of the contract possibly as hurriedly disbanded or transferred, all of which means more expense; in addition to which the endeavours to extract as much as possible during the last year or two cause a serious drop in the revenue for the first few years of a new contract.

31. If we now compare the two systems of workings, *i.e.*, that under the purchase-contract system and that of departmental working, we find in favour of the former—

(1) Relief to an undermanned department in a reduction of organisation and clerical work allowing of more time being devoted to works of improvement.

(2) A more complete working of the forests, all marketable produce being extracted at the same time.

(3) Less risk of failure of the produce coming to hand in time, as if a Government contractor's elephants die or he himself gets ill work at once comes to a standstill and is not completed that year.

(4 A more accurate estimate of the annual revenue (which would probably steadily increase) can be framed.

(5) General assistance to Government in opening up the country.

While in favour of the latter, *i.e.*, extraction by Government agency, we have only a larger profit to Government on the material extracted and sold, which however, as we have seen, may be only temporary.

32. Having virtually established the fact that at all events the major causes combining to the present high price of teak are—

(*a*) The shortness of supplies, more especially of timber of Europe quality;

(*b*) The increased cost of extraction and higher prices ruling in the provincial market; and

(*c*) The increase of royalty under purchase contracts—

it remains to suggest remedial measures. In view of the fact that since this article was commenced a conference of the Conservators in the Province has been ordered to discuss this subject it is perhaps premature to make suggestions here, but, as a previous consideration of such as the writer is prepared to forward may possibly shorten the labours of the conference in question, it may be advisable to do so.

33. As regards (*a*) the shortness of supply. It is only natural that this must tend to increase prices which an increase of supplies would naturally lower; but can this be effected? I believe if necessary it can. The formation of working plans, however, cannot proceed faster than at present, but in the majority of those framed during recent years it has been found that there is a surplus stock on the ground the extraction of which, in order to avoid too serious a drop in revenue at the end of the first period, *i.e.*, some 30 years hence, has been spread over two periods, *i.e.*, 60 years. In view of the fact that a very much more serious drop may occur within a much shorter period by the ousting of Burma teak from the market, would it not be as well to proceed with the extraction of this surplus within a shorter period? In addition the girdling operations in reserves for which working plans have not yet been prepared might be slightly and

cautiously increased with a view to the supply of first class timber only as it is probable that the same state of affairs will be found here, *viz.*, a surplus on the ground and up to the present in the areas already girdled over as much of the first class stock as possible has been left standing; of course if it was found that such action was detrimental to the future welfare of the forests it would have to cease, but the present girdling operations over these areas have been framed on very meagre examination and statistics.

34. Further, in those localities where it is found that departmental extraction is unable to cope *to the full* with the amount of material available departmental extraction might be restricted to a smaller area and the remainder given out on purchase contracts. We have already seen that by the latter all marketable produce is more quickly removed, and it is possible that the increased outturn will considerably help to make up any deficiency in the diminution of profits under the extraction by departmental agency should such be reduced. With a view to reducing the cost of extraction by lessees, purchase contracts for longer periods might be issued with a guarantee of renewal provided work was satisfactory; while in the case of a proposed change in the rate of royalty or of new areas being thrown open arrangements for their working might be made some two years at least beforehand to allow of gradual organisation; and instead of at the last moment putting either girdled timber or new areas up to public tender. These might be allotted at a *fair* rate of royalty to different existing lessees in proportion to their capability and working power or to new-comers who have satisfied a full enquiry into their financial position and power of satisfactory working.

35. Under the last head (*c*) it is almost impossible to make any suggestion. It would seem at first sight, considering that we are also working departmentally, easy to fix a rate of royalty based on cost of extraction and market value, but although it has been attempted for many years no satisfactory solution has yet been found. It is quite impossible, although dividends are annually declared, to obtain any idea of the amount of capital invested, and I very much doubt if any private concern would

care to have it accurately known. In any case I am of opinion that very little improvement can be attained by a consideration of any of these three factors separately, and even considered together it is impossible to predict the ultimate result of the adoption of the above suggestions.

36. In writing the above I must disclaim any special commercial knowledge or training which if I possessed might place me in a better position to discuss the financial aspects of the case. I can only lay claim to 25 years' continuous service in the Province, during the whole of which time I have been in close contact with the working of the forests in all parts under both systems, and have had constant opportunities of discussing the subject from all points of view with nearly every one connected with the trade; and I can only say the facts are there; the conclusions I have drawn may be correct or not, while I must leave the solution of the question to others and to the future.

NOTE.—Since the above was written the following further information bearing on the subject has been obtained from the report on the trade of Bangkok for the year 1904 by Mr. Acting Consul Lyle.

During the year under review 77·531 tons of teak valued at £560·174 were exported as compared with 1903. These figures show an increase of 19·385 tons over the exports during 1903 and of 29·450 tons over and above the average exports of the years 1899—1903.

The exports were declared as follows:—

	Tons.
For the United Kingdom	1,355
„ India	43,785
„ Europe (exclusive of the United Kingdom)	11,104
„ other countries	21,284

Some 138,000 tons arrived at the Revenue Station during the year, but of this not more than about 10 per cent is considered of Europe quality; 60 per cent fit for the Indian and other Eastern markets, while the remaining 30 per cent would be converted into

building material for local use. It is anticipated that owing to shortness of supplies within the next three or four years this output will fall to 35,000 tons annually at the most, as the more remote forests from which the waterways drain into the Mekong are reported, even with the present high prices prevailing, to be too inaccessible and costly to work.

The present local value in Bangkok of timber of Europe quality is quoted at £8 to £10 for squares and £9 to £12 for planks.

If these predictions are fulfilled it will diminish the competition against Burma teak and may lead to the diversion of working power and capital from Siam to Burma.

T. A. H.

NOTE ON THE GERMINATION OF TEAK AND OTHER SEEDS.

BY R. S. PEARSON, I.F.S.

Some Notes on this subject submitted by me to the Conservator of Forests, Northern Circle, Bombay, were forwarded by that officer and published in the March, 1905, number of the *Indian Forester*. Having again had the opportunity of watching the germination of various species of seeds, under various conditions, in the Central Nursery of this division, it may be of interest to add some further remarks to my last Note on this subject.

On page 169 of this volume are given three methods by which it was attempted to accelerate the germination of teak seed, and method No. II, called the "Modified Burman Method," is shown as having given by far the best results.

This year similar experiments were made, but with much poorer results. Soon after the prepared seed was sown in the seed beds there were two abnormally heavy falls of rain, one on the 9th July, which gave 10 inches, and another on the 22nd, 23rd and 24th, giving a total of 16 inches. On both these occasions the raised seed beds were flooded and stood for a considerable time under water. To this flooding may partly be put down the failure

to make the seed germinate. The other circumstance which probably helped towards the bad results was that the seed was not fermented sufficiently during preparation.

The seed treated according to method II was watered and mixed the same number of times and in the same way as last year, when excellent results were obtained, but this did not bring it to a sufficiently advanced stage to germinate readily on sowing, and it still required longer treatment. My camp was in districts at the time, and the mali in charge got alarmed by seeing a few seeds at the top of the mass showing signs of germinating, and, fearing to spoil the seed, stopped watering, though the bulk of the seed was really still below germinating point. The first reason given for failure is the flooding of the beds, the result of which was to subject the seed taken from the warm moist earth of the germinating pits to a prolonged cold bath when on the point of germination, and matters were not improved by a month of sunless weather during which the soil in which the seed was sown never got a chance of warming up again.

The second reason given is insufficient preparation of the seed in the germinating pits. The exact point to which the process should be carried can only be found by careful observation and experience. I am, however, of opinion that it is better to carry it a little too far and chance losing a few seeds than to underforce germination, and so fail to raise the required number of seedlings, besides probably spoiling the seed for next year.

To form a rough estimate of the relative success obtained under method II this and last year it may be stated that with approximately the same seed-bed area and the same quantity of seed, only 15,000 seedlings have so far been raised against 50,000 last year, the seed in both cases being collected from the same area, and apparently of equal quality The shortage of seedlings this year is serious in that there are not sufficient plants to fill the transplant beds in the nursery To remedy this, attempts are now being made to start the seed germinating again. The weather being fine and hot, the earth in the beds has become dry and warm, and they are now being watered on alternate days, as is done in

method II. This has set up a state of conditions somewhat similar to that when seed is in the germinating pits, *i.e.*, alternate heat and cold resulting in very damp warm earth, and though the earth in the seed beds does not approach the very hot damp heat of the seed pit, it has had the same effect, though modified, and the seed has again started to germinate fairly freely.

To the three sets of seed treated by the three methods before described, four more sets of seed sown under different conditions have been tried. They consist of (1) this year's seed unprepared, (2) seed two years old also unprepared, (3) seed subjected to a slight grass and leaf fire, similar to a January forest fire in a dry teak zone, (4) seed subjected to a severe grass fire, similar to a May fire. All four sets of seed were subjected to heavy rain and flood as described above. Of number (1) no seeds came up; of number (2) only 18 or 20. This is curious as all previous observations have shown two-year-old seed to germinate well. Number (3) shows by far the best results, and with watering new seedlings are daily appearing. Number (4) produced nothing.

The experiments on the whole have shown poor results compared with last year, but it is hoped to again try such experiments especially with seed subjected to a light fire, as if it is true that a slight fire sets up conditions which help towards germination, it might possibly be another helping factor in the better regeneration of certain fire-burnt areas in Burma. As regards other seeds, the most interesting point arrived at is the successful results in making dhawra (*Anogeissus latifolia*) germinate. In my former note I stated my incapability to make dhowra germinate satisfactorily. This has been overcome by sowing the seed on well irrigated raised beds, the soil being mixed with a large quantity of coarse sand, the seed sown in June, and daily lightly watered by hand. The reason for trying a very coarse sandy bed was that most excellent natural regeneration of dhawra was found in the Sampa jungles of this division, on the top and slopes of rocky ridges, the soil being of a coarse sandy nature, formed by the disintegration of a granite, containing a high percentage of large felspar crystals. These ridges were naturally well drained and the soil covered by an open crop

of mixed jungle, containing, amongst other species, dhawra. At first the seed could not be made to germinate in the seed beds, and not until about 20 days after sowing was there any sign of germination. It was then seen at one end of one of the beds which was heavily shaded by the branch of a tree. Only one or two seeds germinated in the other part of the beds, nor was the number much increased, though watering went on for a fortnight. I then covered one of the beds with a thick covering of leaves and branches some 18 inches above the ground, so as to form fairly dense shade, and within three days there were a mass of seedlings coming up, the other beds remaining in practically the same state as before.* I have little to add regarding other species. The only new species sown was Nirmali (*Strychnos potatorum*), which is much used in these parts for cart shafts. It took six weeks after sowing to germinate. The seed when commencing germination forms two very delicate light-green cotyledons, embedded in a milky-white horny endosperm, which they absorb before breaking through the testa. The radicle is soft, white, and easily broken if the seedling is disturbed before becoming fit to transplant.

The results of the plantations are satisfactory; an acre of pure teak plantation when counted gave in its third year 21 per cent of failure, which taking into consideration the locality and rainfall is fair. The transplanting of small khair (*Acacia catechu*) has been found to be extremely difficult, as many fail, and it is doubtful if it is worth the expense. The only results at all favourable with khair are those when carried out with large plants. Teak plantations are most successful, those of Bia (*Pterocarpus marsupium*) and sewan (*Gmelina arborea*) come next, dhawra and Ain (*Terminalia tomentosa*) next, and for khair I would recommend direct sowing as is done with Babul.

A photograph of the Central Nursery, Godhra, is sent herewith (*vide frontispiece*), and may be of interest.

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* The dhawra seed failed entirely at Godhra last year. This year our dhawra at Bandra failed. Our Bandra experiments may perhaps be reported later. My object is to show how little is our sylvicultural knowledge, and to incite others to help in elucidating problems of natural regeneration.—(*Note by F. Gleadow.*)

A METHOD OF IMPROVING THE DRINKING-WATER IN THE TARAI.*

BY W. H. MORELAND, C.I.E., I.C.S.

DIRECTOR, DEPARTMENT OF LAND RECORDS AND AGRICULTURE, UNITED PROVINCES.

The improvement of the drinking-water in the tract of country known as the Tarai is a matter of importance from the agricultural point of view, inasmuch as the badness of the water is one of the principal causes why tenants are so hard to get and to keep. The general conditions of life in this tract may be briefly described as follows: The soil is as a rule fairly productive when effectively tilled, and there is no reason to doubt that many parts of it would flourish if an adequate resident population could be secured. But under existing conditions this is almost impossible: when a landholder has spent his money in settling a number of tenants and bringing part of a village under cultivation, a single bad year is usually sufficient to clear off most if not all of the tenants; some die, and the rest abscond. The unhealthiness of the life is really the main defect of this tract: specific diseases, of which malaria is the most common, account for most of the actual mortality, but the important point is that the people are never really in good health, and consequently they fall an easy prey to any disease that may make its appearance.

I cannot find any record of medical investigations into the causes of this chronic ill-health, but the people themselves are unanimous in blaming the drinking-water; and the following extracts show that this view is not based merely on prejudice. Thus the Settlement Officer of Shahjahanpur says of part of the northern tahsil of Pawayan: "The whole place is very unhealthy on account of the bad drinking-water. The Bhainsi (a stream) and all wells sunk near it are poisonous; it is only in a few places here and there that the water is fit to drink."

Similarly the Settlement Officer of Moradabad says of tahsil

*Published as Bulletin No. 20 of the Department of Land Records and Agriculture, United Provinces (1905).

Thakurdwara: "The climate is not good where the tarai influences it; the excessive moisture and the bad drinking-water render fever prevalent."

Again, the Settlement Officer of Kheri wrote recently: "To the ordinary man the pargana (Pallia) is poisonous in the extreme. The water was so abominably bad that it was necessary to have it boiled before bathing in it; and even after boiling it was so greasy and malodorous that powerful disinfectants were required to make a bath even tolerable."

On the same point I may quote the report of my supervisor, who conducted the investigations which are about to be described: "In this village of Jafirpur" (he writes from the Naini Tal tarai) "so long as I used the well water, my men and I always complained of bad digestion; but when we began to use the pipe water, very soon the food is digested; and this is also the opinion of my men."

There is no risk in concluding that water is injurious to drink when a European officer cannot stand it in his bath.

It was decided to begin the investigation of this question on the Government estates in the Naini Tal tarai, where the evil is very widespread. My supervisor, M. Ahmad Husain, was therefore deputed to this estate, with the ready assent of the Superintendent of the Tarai, and made a detailed and most intelligent study of about forty wells, taking trial borings where necessary. His enquiries showed that where the water was good it came in every case from a layer of clean sand, while the bad water was drawn from a layer of dark earth known locally as *lell*. The inference was drawn that this layer contaminated the water passing through it: the *lell* is of a blackish colour, with a bad smell when moist; it shrinks by nearly one-half its bulk when dried, and swells again when moistened. Small samples of this soil were analysed by the Agricultural Chemist to the Government of India, and found to contain respectively 6·2 and 5·4 per cent of organic matter. Seeing that this layer of *lell* is now twenty feet or more below the surface of the ground, the objections to drawing water from it are obvious.

The investigations also showed that in nearly every case it was possible by carrying the well deeper to reach a plentiful supply of pure water: some way below the *lell* an impervious clay stratum is usually to be found, and below it a bed of water-bearing sand, analysis of which shows that it is a suitable source for drinking water. In the two cases referred to above where the *lell* contained 6·2 and 5·4 per cent of organic matter, the lower water-bearing strata contained only 0·32 and 0·15 respectively of organic matter. Thus on the whole it was clear that the bad water was due to the wells not having been sunk far enough, and that by going deeper good water was procurable.

In these circumstances one obvious remedy would be to close the existing wells and sink tube wells direct to the good water, with no possibility of contamination from the *lell*. But the habits and feelings of the people have to be considered: it is no use trying to force a novelty on people who are quite ready to leave the village at a day's notice, and whom you could not replace without much trouble and expense; and the people prefer *the kind of well to which they are accustomed.* It was decided therefore to alter the existing wells. This has now been done in the case of two wells situated eighteen miles apart, and the result is so promising that the method may be recommended for trial by all landholders whose villages suffer from the same defect.

The following is an outline of the process adopted: An iron pipe, two inches in diameter, is sunk through the bottom of the well, as in an ordinary boring, until the supply of pure water is struck. This water then rises into the existing well, and (in the case of the completed wells) in ample quantity. The well must then be so plugged that the *lell* water cannot get in: it must be thoroughly cleaned out, and a floor of concrete laid down with the pipe projecting through it. The masonry of the well-cylinder must also be carefully examined and the mortar renewed wherever it has given way, the object being to prevent water getting into the well from any source except the pipe. For the same reason the well should be provided with a platform above ground if one is not already in existence, and if the masonry of

the cylinder is seriously defective it may be desirable to surround it outside with a coat of well-puddled clay; or in exceptional cases to sink a new masonry cylinder inside, leaving a space of six inches between the old and new cylinders, which can be filled in with concrete when the new cylinder is sunk. The cost of these operations will naturally vary widely according to the condition of the cylinder; but for an ordinary well, six feet in diameter and in ordinary repair, the cost may be estimated at about Rs. 150 to Rs. 170.

The use of a two-inch pipe as described above will ordinarily yield an ample supply of water for all domestic purposes, but it will not give enough to serve for irrigation. If a well is wanted to serve both purposes, two courses are open: either the diameter of the pipe may be increased to four inches, or a narrow cylinder may be sunk inside the existing cylinder and carried down to the good water.

If a new well is to be sunk, the most important matter is to see that the cylinder is sunk at least ten feet below the bottom of the *lell*, and so far into a different stratum that the *lell* water cannot reach the well.

Landholders who desire to improve the water-supply of villages in the tarai or similar tracts are advised to have a trial boring made in every case, and in any case of difficulty to consult the supervisor employed by the department, who will give full instructions for the treatment of the well. Application for advice should be made in the first instance to the Assistant Director, Department of Land Records and Agriculture, Cawnpore.

SCIENTIFIC PAPERS.

SOME INDIAN FOREST FUNGI.

BY E. J. BUTLER, M. B., F. L. S.

CRYPTOGAMIC BOTANIST TO THE GOVERNMENT OF INDIA.

PART IV.

THE BARBERRY RUSTS

The classical example and the first known of the power of changing hosts (heteroecism) in the rust fungi is that of the black rust of cereals, Puccinia graminis. About 90 years ago a Danish schoolmaster named Scholer discovered that the dust in the cluster cups (Ecidia) of the common barberry was able to induce Puccinia graminis when shaken on rye. From that

small beginning the study of the cereal rusts, those most destructive of all known fungus diseases, has been built up. Of late years the opinion has grown with many observers that the stage of the disease passed on the barberry may be dispensed with, and that the uredo and teleuto stages may appear year after year on corn without any intervening æcidial stage.

In India it is certain that this is the case. The last few years' observations have shown that Puccinia graminis is one of the commonest rusts in the central areas of India. The barberry, on the other hand, is confined to the higher mountains—the Himalaya and one or two other high ranges or peaks. Last year (1904) Puccinia graminis was found in every wheat field in places over 600 miles from the nearest barberry, a distance through which it is absurd to suppose that æcidiospores could be carried by the wind in any quantity. It is almost equally certain that no other plant occurs in these areas which replaces the barberry as a host of the *Æcidium*. The statement often repeated that the cereal rusts are largely caused by the leaf fungi of the Himalayan forests is therefore devoid of foundation.

Even the study of the barberry *Æcidia* themselves shows how little they can be called into question in this connection. For the true *Æcidium* Berberidis of the cereal black rust is a species whose range in the Himalaya is restricted. So far as present investigations tell it does not appear east of Simla. Around Simla it undoubtedly occurs on Berberis Lycium, and probably also on B. coriaria Royle, B. aristata D. C., and a species which has been doubtfully referred to B. umbellata Walt. It probably also occurs on B. vulgaris to the west of Simla, where alone this species is found.

The odd thing about this is that it is precisely at the only part of the Himalayan range where *Æcidium* Berberidis is known to occur that black rust is extremely rare on cereals. In many years' search Barclay only once found it on wheat near Simla. It is, however, common on a wild grass, and with sporidia from this Barclay succeeded in producing the *Æcidium* on B. Lycium. The only conclusion to be drawn is that the form found

on the wild grass is a specialised form, which neither in its uredo nor in its æcidial stage can pass to the cereals. Hence even where

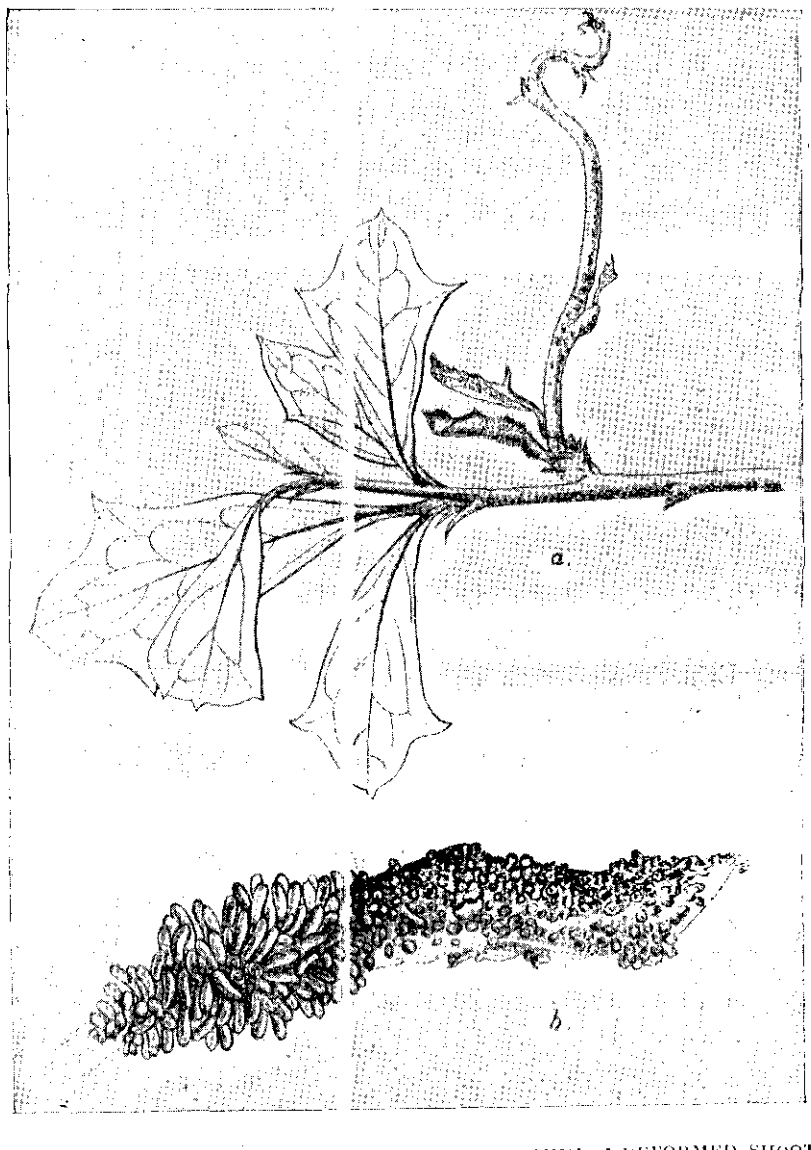


FIG. 11.—ÆCIDIUM MONTANUM ON BERBERIS LYCIUM. *a* DEFORMED SHOOT TURNED VERTICALLY UPWARDS (NAT. SIGE) ; *b* A LEAF BEARING ÆCIDIA (MAG. 4 TIMES).

the Æcidium is found its influence on the rusting of cereals is slight. A number of similar cases of this specialisation or splitting up of a parasite into races each confined to one variety of host are now known.

East of Simla Æcidium Berberidis is replaced by a second species of much interest. I have received it from several Forest officers from Jaunsar on B. coriaria, B. aristata, and B. Lycium, and it is abundant around Mussoorie. It is at once distinguished from the other by the peculiar deformity of the affected branches. A witch's-broom formation is induced on attacked parts, sometimes involving as much as half the bush. All the new shoots show negative geotropism or a tendency to grow vertically upwards. The Æcidia are found on small deformed leaves surrounding the buds or on specially modified shoots arising from the latter. These shoots are soft, blackish and curiously twisted in many cases and bear only spines or small, often deformed, leaves. The æcidial cups are formed on the under surface only of the leaves, but are scattered irregularly on the shoots. The floral peduncles are sometimes attacked and also some nearly normal shoots, which are, however, blackened over the area which bears the parasite. All the deformed parts contain a perennial mycelium in the interior of the tissues from the influence, of which no doubt the new growth shows its peculiar characters.

A second form, confined to the leaves, is also found, and from its characters seems to arise from infection anew by spores, and not from the perennial mycelium. Fully developed normal leaves are attached, the fungus producing large reddish or bright scarlet patches on the upper surface, and numerous very long tubular Æcidia below. Little deformity results, at the most a puckering of the leaves.

Intermediate forms between the two extremes described are frequent. Sometimes from a rosette of the stunted deformed leaves of the first variety a few normal leaves may arise, some of which have large patches of the second kind of attack. The appearance strongly suggests a secondary infection of normally developed leaves either by the æcidiospores themselves or by

sporidia from another host bearing the teleutospores. A second host is, however, unknown

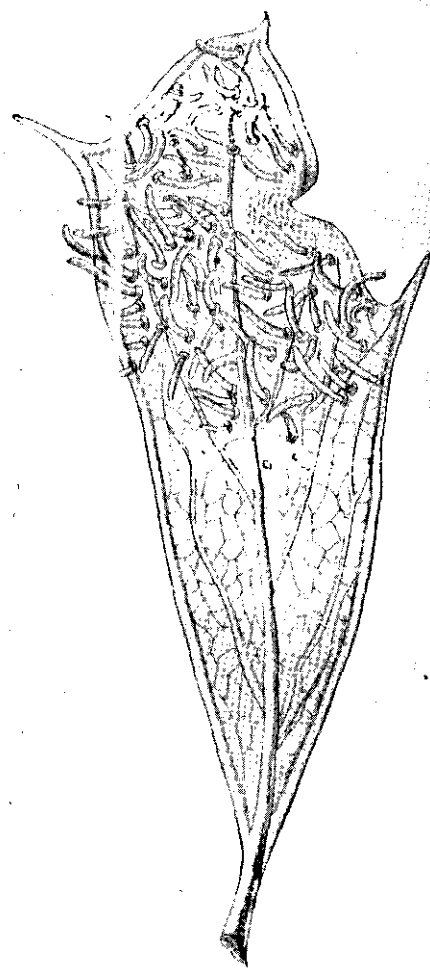


FIG. 12.—ÆCIDIUM MONTANUM ON A NORMAL LEAF OF BERBERIS LYCIUM (ENLARGED).

The first form is found from May until the old weather, and perhaps continues during the latter, while the form on normal

leaves appears in June and July. Experiments have shown that neither form can infect cereals.

The influence of the parasite on the host may be summarised as follows: Dwarf shoots are produced at the nodes of a branch either as a result of infection from a perennial mycelium below or from new infection of the undeveloped bud by spores. These are formed during a considerable part of the year. Small deformed leaves arise on them, the internodes being much shortened, while the axis is thickened. As a result a cylindrical formation about half an inch in length, densely crowded with scales and minute fungus-bearing leaves, is produced. The leaves then fall, leaving the persistent scales while new buds may be formed in the axils of the fallen leaves. At the same time the peculiar succulent Æcidia-bearing shoots referred to above arise either in prolongation of the main axis of the dwarf shoot or from a lateral bud. Sometimes the whole of this, which may be 6 or 8 inches in length, is a spore-bearing organ, sometimes a part only; it is not uncommon also to find that the lower part alone bears the fungus while the upper has grown on into a harder thorny shoot approaching the character of a normal one. Leaves may be formed on this prolongation, but they are usually small, while the part which bears Æcidia is as a rule devoid of leaves or, if provided with any, they are deformed Æcidia-bearing ones. The portion of the shoot on which the fungus is found fructifying is always more or less blackened and rounded, usually hypertrophied, while the normal shoots are covered with a greyish bark and are angular. Normally developed leaves can also be attacked and produce large Æcidial patches unattended by deformity. Sometimes bushes are found with only this leaf form unaccompanied by any witch's-brooms.

In a section of one of the modified shoots bearing the Æcidia the perennial mycelium may be very easily detected. All the tissues are affected, with the possible exception of the cambium. The hyphæ run in the walls and intercellular spaces. Their contents frequently show yellow oil-drops. Haustoria for food aquirement are simple or branched finger-like processes, which

appear to be sometimes covered with a protrusion of the cell-wall such as is found in the haustoria of the Erysipheæ. Hypertrophy is slight and is chiefly found in the dwarf shoots which arise from infected buds and grow as short thick axes crowded with minute leaves.

Three fungi are known on species of barberry in other countries resembling this. One, Æcidium Magellanicum Berk., was found on B. ilicifolia in Terra del Fuego. Its Æcidia are found often on the petioles. Another, Æcidium graveolens Shuttlew., is connected with a Puccinia on Arrhenatherum in Europe and produces a complex and constantly increasing deformity while the Æcidia are sometimes found on the upper surfaces of the leaves. The third is Æcidium Jacobsthalii Henrici Magnus, which appears to have no spermagonia and to produce considerable thickening of the branches. Its æcidial cups are also short. The Himalayan species cannot be identified with any of these, and I have called it Æcidium montanum. Its diagnosis is as follows :—

Æcidium montanum Butl. n. sp. Maculæ absent or brilliant crimson with a black centre on the upper surface of the leaf and pale red below; spermagonia scattered on deformed shoots and leaves, or crowded in the black centre of the maculæ, chiefly epiphyllous but also hypophyllous in a group in the centre of the æcidia, black, sunken, flask-shaped, broader than deep, 65 micro-millimeters deep below the epidermis, 120 m. mm. broad, paraphyses 3 m. mm. broard, projecting in a stiff bundle from the mouth to 50—75 m. mm. above the surface; spermatia minute, set free with mucus; æcidia numerous and crowded on the whole of the under surface of the leaves or on patches ¼ to ¾ in. in diameter; pseudoperidium elongated to 4 mm. on the underformed leaves, rarely more than 2 mm. on the witch's-brooms, orange below, whitish above; æcidiospores orange, irregularly globose, ovoid or angular, 17-35 × 17-29 (average 19 × 23) m. mm. in diameter, epispore *finely wrinkled*.

On Berberis Lycium Royle, B. coriaria Royle, and B. aristata D.C. in the N.-W. Himalaya.

PUCCINIA DROOGENSIS N. SP.

In the Niligri Hills Berberis aristata was much rusted in 1904. The rust, however, differed from those described above, for, while the uredo and teleuto forms were abundant on the leaves, I could not find any Æcidia. Even if Æcidium Berberidis should occur on these hills it can be of but little economic importance, for wheat cultivation is not common in South India.

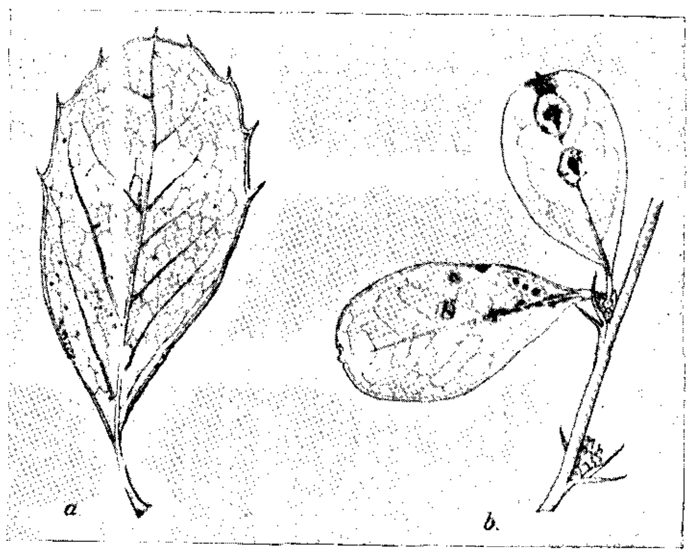


FIG. 13.—PUCCINIA DROOGENSIS ON BERBERIS ARISTATA. *a* UREDO STAGE; *b* TELEUTO STAGE.

The species does not agree with any already described, and I have named it Puccinia droogensis. Its diagnosis is as follows:—

Puccinia droogensis n. sp. Uredosori amphigenous, sparse, small, long covered with the epidermis, yellow, in irregular maculæ pale with a red centre on the upper surface of the leaves; uredospores long-elliptical or clubshaped, yellow, 15-21 × 27-42 m. mm. in diameter, epispore up to 3 m. mm. thick with regular scattered spines; teleutosori on purple maculæ, amphigenous, pulvinate, confluent, irregular, ¼ to 1 m. mm. in diameter; teleutospores elliptical, both ends rounded, constricted at the septum,

brown, 30-45 × 18-24 m. mm in diameter, epispore very thick and marked with tubercles arranged in series.

On Berberis aristata D. C. in the Droog, Nilgiri Hills, altitude 6,000 ft., October 1904.

GAMBLEOLA CORNUTA MASSEE.

Berberis or Mahonia nepalensis bears a remarkable rust in the Mussoorie and Jaunsar Himalayas. This is the species from which Mr. Massee of Kew derived the new genus Gambleola, named in honour of its discoverer, Mr. J. S. Gamble, F. R. S., of the *Indian Forest Service. The species is known as Gambleola*

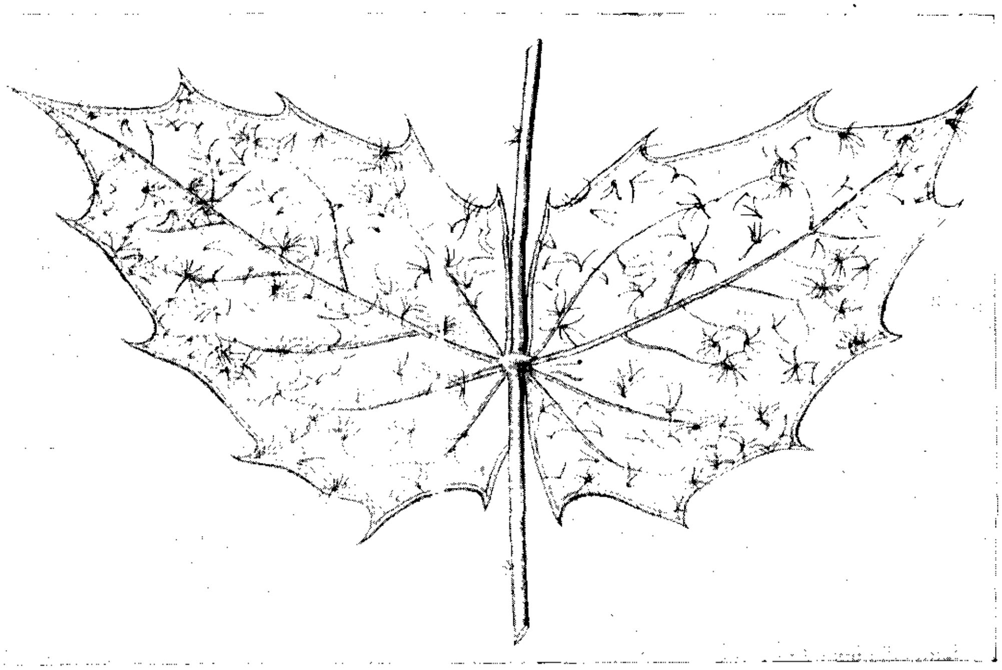


FIG. 14.—GAMBLEOLA CORNUTA ON BERBERIS NEPALENSIS.

cornuta. It appears in the form of long black wavy hairs grouped in clusters on the under surface of the leaves and sometimes also on the twigs. Each hair consists of many chains of two-celled teleutospores adhering closely to one another in the chain and

Forêt de Retz (Beech), France, visited by the Cooper's Hill Forest Students.

also to adjoining chains. No other spore form is known, and it would be a matter of extreme interest to follow out its development and ascertain its life-history. This must be left to those fortunate enough to live near the haunts of Berberis nepalensis; but there are few pursuits of more absorbing interest than to trace in such fungi as this the varied changes of form, associated as they so often are with an alternation of hosts.

ORIGINAL ARTICLES.

THE FORESTRY BRANCH AT COOPERS HILL.

BY W. R. FISHER, B. A.

Coopers Hill is an ideal place for a Forest School. With 100 acres of land, about 25 of which are woods, with splendid playing-grounds, easy access to the river Thames, a good rifle-range and gymnasium, and excellent buildings for class-rooms, laboratories and the accommodation of students, a finer institution for the mental and physical training of young men could not have been established. Situated high up above the Thames valley and its fogs, on the plateau of the Bagshot sands, in the immediate vicinity of Windsor Park, with 4,000 acres of bracken and heather containing groups of magnificent forest trees, and with a real bit of old English native woodland in the birch and oak of Englefield Green, the students in their first tour soon learned to distinguish between the different species of trees and shrubs. The woods of Windsor Forest, 10,000 acres in extent, with extensive crops of Scots Pine in all stages of existence, and with 1,200 acres of oak wood about eighty-five years old, from which a working-section of oak forest might easily be formed, afford an excellent training ground for the more advanced student. There are about 50,000 acres of beech-wood managed under the selection system, with natural regeneration in the Chiltern Hills, within a day's drive, while an excellent Crown coppice-with-standards, at Orshott, is within 14 miles of the College and contains an area of over 800 acres.

From 1890 to 1900 the College leased about 800 acres of pine wood and heather waste from the crown near Cæsar's Camp, where the students learned to plant and to thin the woods, and protect them from the dangerous heath fires. Here, also, they formerly prepared forest working plans, which work is now done in Germany. Since 1900, after all the waste land in Cæsar's Camp, 400 acres, had been planted and its management resumed by the Crown, Mr. F. Simmonds, the Deputy Surveyor of the Forest, has kindly given the students every possible facility for working, as before, in different parts of the forest. The Thames river-beds afforded another practice ground, and so did the excellent nursery at the College started by Dr Schlich in 1885. Here the students sowed and planted and studied nursery-management, the nursery supplying 60,000 four-year-old pine plants annually during our tenure of Cæsar's Camp, which were planted out there; while since 1900 the plants, always exceptionally good ones, have been sold and planted in various woodlands all over England.*

In 1891 Dr. Schlich planted in the College grounds, on a sloping sandy loam, with a northerly aspect, some model plantations, which are now 14 years old: being the only ones of the kind in Britain, they have been visited by numerous foresters. Pure Silver-fir, spruce, Douglas fir, Scots and Weymouth pine, and larch, also pure beech, hornbeam, alder, birch and oak, and mixtures respectively of larch, oak and Scots pine in the beech and Silver-fir, constitute the chief crops. There are also instructive mixtures of ash and oak, the oak being all killed out, and of ash and alder in which the alder is rapidly killing the ash. These show the effects of fast-growing species on slower-growing light demanders.

The crops are each one quarter of an acre in extent, or somewhat less, but they are large enough to show the effects of light and shade and close and open growth on young trees, and afford

* Some hundreds bought by myself when on leave in 1897 and planted near Crowborough in North Sussex: have made the most wonderfully rapid growth. —HON. ED.

R. I. E. College, Cooper's Hill.

excellent examples of the comparative rapidity of growth of species during youth. In the larch and beech woods, the larch poles, now 17 years from seed, are 40 feet high and over two feet in girth at the base, while the girth of the pure larch averages nine inches less, although the poles are still 40 feet high. These pure larch crops have now been under-planted with silver-fir and beech. The immunity of the larch from disease is complete in these plantations, although there are crops of larch ruined by the larch fungus (Dasyscypha) within two miles.

The long afternoon autumn and spring rambles in the various woodlands I have here described, where the students have done their full share of practical forest work, have afforded the best possible means for sylvicultural instruction; while during summer, whole days have been spent in the more distant woods. It is sad to think that we cannot transfer our nursery and the model crops of trees to Oxford, with our Museum and Library; but there we hope, through the liberality of St. John's College, to start similar plots in the Bagley wood of 650 acres.

Dr. Schlich, then Inspector-General of Forests in India, started the Forest training at Coopers Hill in October 1905. He was at first the only Professor of Forestry, while Mr. H. Marshall Ward was Professor of Botany. The students were admitted to the College after passing a competitive examination in the following subjects: -

1. Handwriting, Orthography, and English Composition.
2. Elementary Mathematics.
3. Mechanics, Physics, Botany, Mineralogy, and Geology.
4. Inorganic Chemistry.
5. Geometrical and Freehand Drawing.
6. French or German.

It will be noticed that the subjects were essentially scientific, and, as long as this system of examination prevailed, the Forest students constantly obtained prizes at the College for Science, prizes which were also open to the Engineering students.

The Forest students remained at the College for two years, under the same general regulations as those applicable to Enginneers, and their work in Physics, Geology, Inorganic Chemistry, Surveying and Geometrical Drawing and, to some extent, in Mathematics, was the same as that done by the latter. A special course of Forest Engineering was given to our students. At the end of the second year, the students spent about three months in studying in detail certain forest districts in Great Britain and Germany, this being in addition to occasional excursions to woodlands made during their stay at Coopers Hill. Mr. A. Shipley, *Fellow of Christ College, Cambridge,* was, in 1887, appointed Lecturer in Entomology to the Forest Branch.

In 1888 Sir Dietrich Brandis, K. C. I. E., F. R. S., was appointed Director of the Practical Study of Forestry, and conducted the tour in Germany. Professor A. H. Church, F. R. S., was also appointed Instructor in the Chemistry of Soils and Vegetation, and gave a special course of lectures to the Forest students.

The first batch of Assistant Conservators of Forests, Messrs. Rogers, Hart, Hill, and E. G. Oliver, who had been trained at Coopers Hill, went out to India in 1887.

Mr. W. F. H. Blandford succeeded Mr. Shipley as Lecturer in Entomology in 1889. In 1890 Mr. W. R. Fisher, Conservator of Forests in India, was appointed Assistant Professor of Forestry, and in 1891 the first-year students at the end of their first year's course went for a fortnight's tour in the French broad-leaved forests in Normandy, this tour having been continued ever since: in 1900, however, the forests at Compiégne, Villers Cottorêts, and Valenciennes were substituted for the Normandy forests, and the Forest at Le Quesnay added in 1905. Detailed work in marking trees for felling and thinning, under the compartment system, with natural regeneration, was then done by the students, while they also visited two pine woods under coppice-with-standards

In *1890 the course of study was raised from 24 to 34 months,* divided into nine terms. During the first eight terms the students studied at the College and the remaining term was spent in

The Forest Museum.

Germany. It was then also laid down that, with the special permission of the President, students not nominated by the Secretary of State for India for the Indian Forest Service might be received at Coopers Hill, either to follow the whole Forestry course or to participate in the instruction given in certain subjects only. The only students who have benefited by this provision are five from Cape Colony, one from Mauritius, four from Native Indian States, one from Ceylon, one from Siam, and two from the Malay States. This regulation provided for both resident and non-resident students, but its provisions were not generally known, so that very few presented themselves for the course, and in two cases its benefits were disallowed by the President, so that we have only had two non-resident Forest students.

Mr. B. H. Baden-Powell, C.I.E., late of the Indian Civil Service, was appointed Lecturer in Forest Law in 1891, the subject of his lectures forming his well-known "Manual of Indian Forest Law." In June 1891 a change was made in the entrance examination for Forest candidates, which was in future to follow the lines of the examination for Woolwich.

The reasons for this change were to discourage cramming a number of subjects and to enable the Public Schools to send candidates direct for the Public Service, but, as many of the students took up no science except Elementary Mathematics, classical men with no knowledge of science frequently passed into Coopers Hill. One of these gentlemen, who sank from first to last in the list, left the College at the end of his first term, and subsequently competed successfully for the Indian Civil Service. Coopers Hill training required men with a decided bent for science, and when the Indian Police Service was recruited by the same examination, as well as Woolwich, our students were frequently beaten by men who were attracted to the other Services.

In 1895 Mr. Baden-Powell resigned his appointment at the College, instruction in Forest Law being given by Mr. Fisher. In 1896 Dr. Marshall Ward became Professor of Botany at Cambridge.

In 1897 Mr. C. A. Barber was appointed Professor of Botany, and also succeeded Mr. Blandford as Instructor in Entomology.

In 1895 Sir Dietrich Brandis resigned the post of Director of the Practical Study of Forestry on the Continent, and Dr. Schlich undertook this work, in addition to his other duties. At the same time, the course of study at Coopers Hill was modified, the students were to remain for seven terms at the College, and to study for five or six months in Germany, being sent generally in pairs to selected forest divisions in Prussia, to work under the local Forest Officers. They finished their work on the Continent with a general tour of six weeks under Dr. Schlich, during which certain interesting forests in South Germany and in Switzerland were visited.

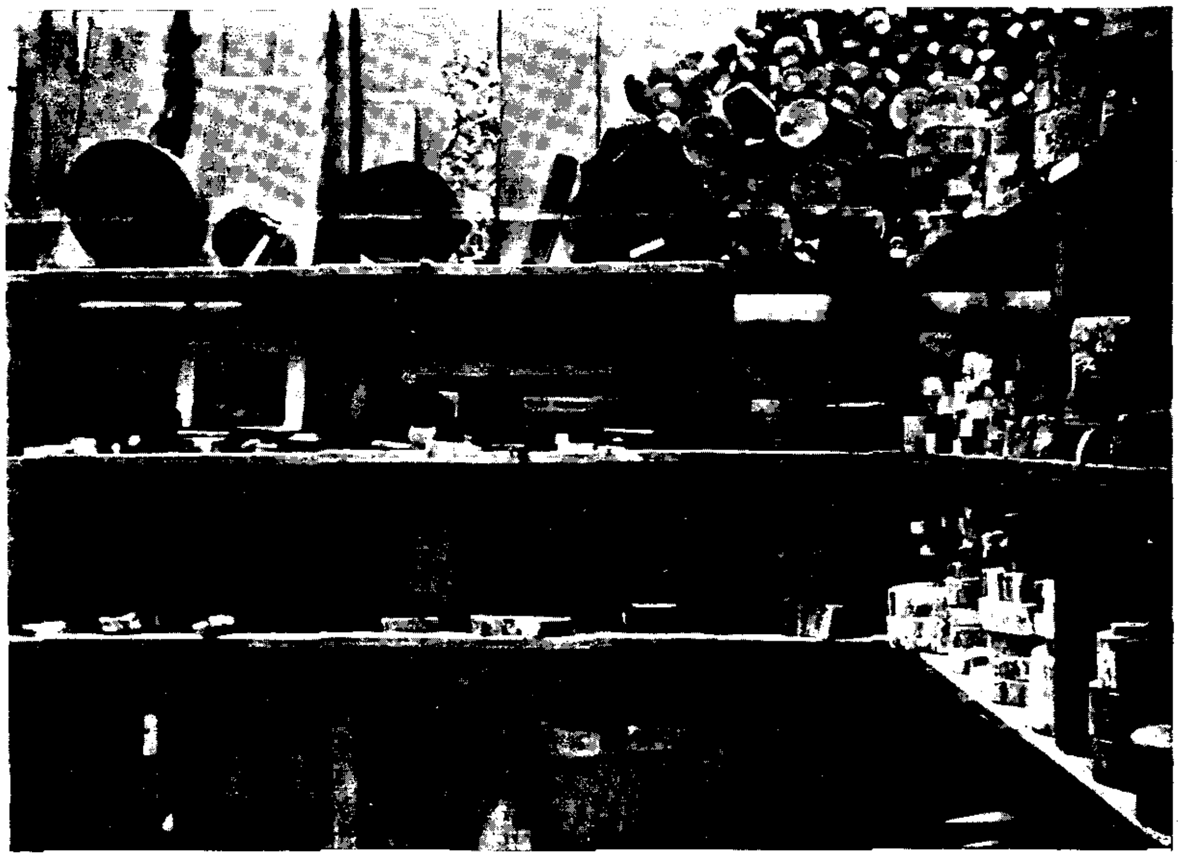
In 1898 Mr. Barber went to India in charge of the Botanical Department of Madras, and was succeeded by Mr P. Groom, who has since taught both Forest Botany and Entomology. Colonel G. F. Pearson, late Inspector-General of Forests in India, and for some years Director of the Studies of English Forest students at Nancy, was appointed one of the Board of Visitors of the College on the retirement of Sir Dietrich Brandis, who had held that post since the commencement of the Forestry Branch at Coopers Hill. Dr. Matthews also succeeded Mr. Church as Instructor in Organic Chemistry. Dr. Schlich was made a Fellow of the Royal Society in the same year.

In 1900 the entrance examination for admission to Coopers Hill of candidates for the Indian Forest Service was modified by dividing the subjects into two classes—

I.—Elementary Mathematics, English Composition, German, and Botany. These were made obligatory.

II.—The optional subjects were the Higher Mathematics, Latin, French, Greek, English History, Chemistry, and Heat, Physics, Physiography, and Geology.

Owing to this change candidates had to show a knowledge of Botany, but the important subjects of Chemistry and Physics were still left optional. The course at the College was also reduced to two years, and nine months assigned to practical Continental training in Forestry.



Corner of Forest Museum—Exhibits of Wood Specimens.

Chemistry and Heat were then added to the list of obligatory subjects for all Forest candidates for admission to the College, so that a certain knowledge of science was again ensured.

Since 1887 the following number of students have passed through the College up to the date of the closure of the Forest Branch, August 2nd, 1905:—

154 have been appointed Assistant Conservators of Forests in India;
9 others have obtained diplomas in Forestry;
9 students are now doing practical work in Germany, and will probably get diplomas next July.

Total ... 172

Of these, twenty have obtained Fellowships at Coopers Hill; of the nine who did not go to India two were declared medically unfit, three have received Forestry appointments in Native States in India, three in Cape Colony, one in Ceylon, and one in Siam. Besides these students, one from an Indian Native State and one from Cape Colony failed to obtain diplomas, and two others, non-resident, who attended only a part of the course, have obtained appointments in Cape Colony and Mauritius.

Of the nine students now in Germany, one is intended for service in the Soudan, and the others will, if qualified, go to India, It is probable that one of them, Mr. Mercer Adams, will be a Fellow of Coopers Hill the last Forester to attain this honour. Fourteen students have also completed their first year at Coopers Hill and will go to Oxford, where they have been admitted to various Colleges, and to Germany for the remainder of their course; two of these are intended for service in the Malay States.

We have to regret the death, on duty, of six of the Coopers Hill Forest men who went to India, and their names are recorded in memorial tablets in the College Chapel. One of these, Mr. Abbey, was a Fellow of Coopers Hill. Mr. Grenfell has retired from the Indian Service, and is now employed in the Transvaal Forest

Service, while Mr. Hanson, who has also retired, is Instructor in Forestry at a school for woodmen in the Forest of Dean.

Much work besides that involved in the instruction of the students has been done by the Forestry Professors at Coopers Hill.

Coopers Hill as a Forest School is no more, but the men trained at the old College have already begun to make their mark, while somewhat of the old *esprit de corps* of the United College of Engineers, Telegraphists and Foresters will remain at Oxford. Let us hope that the Indian scientific services will continue to remember the old bond of union between them and will further good government in India by working in concert. It is also essential for the success of the Oxford College of Forestry that distinguished men, who have every prospect of rising to the highest posts in the Indian Forest Service, should be ready, as was Dr. Schlich, to resign a brilliant Indian position, in order to continue the work he is now starting at Oxford. None but the best of Indian Foresters should be entrusted with such a work.

NOTE ON THE DAMAGE DONE BY THE DROUGHT OF 1899-1900 IN THE PANCH MAHAL DIVISION.

BY R. S. PEARSON, I.F.S.

In the July 1903 *Indian Forester* a Note was given on this subject in which the damage was described and the measures proposed to be taken to minimise the evil were stated.

It was mentioned that, owing to the large number of dead and dying teak and other species standing in the forest, the permanent working plans had to be suspended for four years, ending 1905.

As laid down in the temporary working plan drawn up in 1901, for extracting these damaged trees, one-fourth of the whole forest was marked and felled each year. The teak were numbered and felled for sale, and from these enumerations can be judged the enormous damage wrought by the drought of 1899-1900.

The area worked over was 152,949 acres and the number of teak cut out was 2,782,700 over 9″ girth and 1,415,500 under

Larch and Beech Forest visited by Cooper's Hill Forest Students.

9″ girth, or a total of 4,198,200 trees. These figures speak for themselves in showing the amount of damage.

It is interesting to note the effect of the drought on the trees. The trees affected, soon after the failure of the monsoon, showed signs of becoming stag-headed. The damage then worked slowly down the stem and, finally, the whole portion of the tree above ground was completely dry. This took from two to three years; after that the roots showed signs of drying, and, finally, the whole tree system was completely dead. The fellings of the first two years produced excellent coppice, and the act of felling the dying trees, and so allowing vigorous coppice shoots to come up, caused new roots to form, thus for a time saving the root system. The fellings of the third year produced fair coppice, but not so good as that of the first two years' fellings. This was partly due to the stools having reached a more advanced stage in drying, and also to the very short rainfall in that year. The results of last season's fellings have not yet been carefully examined, but, provided some vitality is still left in the stools, the heavy rains of this monsoon should anyhow give a fair chance of a certain amount of good coppice being produced.

The result of these fellings has naturally much opened the forests, with the result that natural regeneration in fire-protected areas has been above normal, especially of such species as khair (Acacia catechu) and dhaura (Anogeissus latifolia), and teak to a less degree.

The following is a list of trees, giving their respective power to withstand drought as observed in this Division :—

I.—Species not found damaged by drought.—

Kosam	...	Schleichera trijuga.
Sissam	...	Dalbergia latifolia.
Aniar	...	Acacia leucophlæa.
Karanj	...	Pongamia glabra.
Palas	...	Butea frondosa.
Tamarind	...	Tamarindus indica.
Phasi	...	Dalbergia paniculata.
Bherda	...	Terminalia belerica.

	Rohin	...	Soymida febrifuga.
	Banyan	...	Ficus bengalensis.
	Pipal	...	Ficus religiosa.
	Nirmali	...	Stychnos potatorum.
	Bor ...	...	Zizyphus jujuba.
	Al ...	...	Morinda exserta.
	Simal	...	Bombax malabaricum.

II.—Trees slightly affected by drought.—

Very slightly damaged.	Amba	...	Mangifera indica.
	Moka	...	Schrebera swietenioides.
	Mohin	...	Odina wodier.
	Kandol	...	Sterculia urens.
	Gugal	...	Boswellia serrata.
	Kalam	...	Stephegyne parvifolia.
	Haldarwa	...	Adina cordifolia.
	Ganeri	...	Cochlospermum gossypium.
In some places somewhat heavily damaged.	Khair	...	Acacia catechu.
	Bia	...	Pterocarpus marsupium
	Tembru	...	Diospyros melanoxylon.

II.—Species badly affected by drought.—

Very heavily damaged.	Teak	...	Tectona grandis.
	Kakada	...	Garuga pinnata.
	Umbh	...	Saccopetalum tomentosum.
	Mowra	...	Bassia latifolia.
Heavily damaged.	Bili...	...	Ægle marmelos.
	Dhaura	...	Anogeissus latifolia.
	Sadada	...	Terminalia tomentosa.
	Aola	...	Phyllanthus emblica.

THE MUTHODI TEAK PLANTATION OF 1903-04.

BY D. J. EVERS

FOREST RANGER, MYSORE STATE.

It might not be out of place, as an introduction, to give a general description of the Jagur Valley and the Baba Buden Mountains which "completely environ it," and which, according to Rice,

contain one of the highest peaks, Malainagiri, 6,317 feet above sea-level, "between the Himalaya and Nilagiri." Rice thus describes the Baba Buden Mountains—"the loftiest range on the Mysore tableland. The form of the chain is that of a horseshoe with the opening to the north-west. The northern arm commencing with the Hebbe Hill stretches eastwards without interruption for about 15 miles, whence, bending southwards, it presents to the east an unbroken wall of more than 20 miles. The southern arm is formed by the Baswan Gudda and Woddin Gudda ranges. The character of the chain is that of a stupendous ridge 6,000 feet above the level of the sea, and in some parts only a few yards wide at the summit, rising at intervals into loftier peaks. The summit of the hills consists of steep grassy slopes, well wooded in the ravines, through which flow perennial springs. The sides are densely clothed with forests, among which are numerous coffee plantations, as well as in the Jagur Valley, which is one stretch of forest as far as the eye can reach." The Jagur Valley lies beyond the right bank of the Bhadra river. Continuing, the same authority says of the Baba Budens—"projecting as it were like some Titanic bastion, they guard the approaches to the Malnaad or Highland region formed by the congeries of hills and mountains which intervene between the range and the ghauts on the west;" and of the Jagur Valley he further adds—"throughout the Jagur Valley is a continuous stretch of valuable forest, densely clothing the hillsides and giving shelter to much coffee cultivation. Sholas and hanging woods occupy every ravine and hollow of the Baba Budens. In these vast solitudes the habitations of man are few and far between. A single homestead, hidden amid the luxuriance of tropical vegetation, is often the only sign of his presence for many miles around. These vast wilds and solitudes, with scarcely a human habitation, were, until a few years ago, well stocked with every variety of game, from the elephant and bison downwards. The advance of the coffee planter has now forced back the savage denizens to remoter and more secluded spots." At the time Rice wrote (nearly 30 years ago) he says—"Roads there are none. No wheeled conveyance disturbed the peace of the well-nigh trackless

woods save where a space, annually cleared for the occasion, allowed the car of some popular god to be drawn a couple of hundred yards and back from his shrine in the depths of the forest. All the valuable produce of the country was, and to a great extent still is, transported on the backs of cattle, the rallying sounds from the belled leaders of the drove resounding far and wide." But, thanks to the Public Works Department, a local fund road has been since opened from Chikmugalur, the headquarters of the District Forest Officer, to Hebbe, the headquarters of the Jagur Valley Range Office, a distance of 32 miles. At Hebbe the Forest Department has constructed a palatial wooden structure for the accommodation of the Ranger and a remarkably pretty gothic mortar building for the accommodation of Inspecting Officers. Both buildings are situated close to and on the right bank of the Bhadra river.

It might interest your readers to know, on the authority of Rice, that the Baba Buden Mountain is the cradle of the coffee cultivation of Southern India. "The Range is called in the Hindu Pooranas Chandra Drona, but derives its present name from a Mahomedan saint who took up his residence on one of the southern slopes, and is stated to have reared coffee from seeds he had obtained at Mocha. A cave containing what the Mahomedans assert to be the tomb of Baba Buden, but the Hindus to be the throne of Dattraya, is a venerated place of pilgrimage for adherents of both creeds."

The Jagur Valley is considered to be the best wooded part of the Mysore Province. The growth is of a very mixed character, consisting of the following species: Teak, Matti (*Terminalia tomentosa*), Hoonal (*T. paniculata*), Nandi (*Lagerströmia microcarpa*), Bete (*Dalbergia latifolia*), Houne (*Pterocarpus Marsupium*), Cedrela Toona and C. *serrata*, Jamun (*Eugenia jambolana*), Dindiga (*Anogeissus latifolia*), Kakee (*Cassia fistula*), Jambe (*Xylia dolabriformis*), Sagode (*Schleichera trijuga*), Halasu (*Artocarpus integrifolia*), Jalarie (*Shorea laccifera*), Sampege (*Michelia champaca*), Thadsal (*Grewia tiliæfolia*), Bende (*Hibiscus esculentis*), Kanagal (*Dillenia indica*), Bage (*Albizzia lebbek*), Bilwara (*A. odoratissima*), Banni (*Acacia ferruginea*), Honge (*Pongamia glabra*), Genasu

(*Stereospermum suaveolens*), the wild mango, Thupra (*Diospyros melanoxylon*), Jagalagauti (*D. montana*), Tani (*Terminalia belerica*); Burga (*Bombax malabaricum*), and other species too numerous to mention. The large bamboo (*Dendrocalamus strictus*) and the small kind (*Bambusa arundinacea*) are to be seen everywhere, and their feathery culms lend a pleasing feature to the landscape and help to break the monotony of the broad-leaved species. The sandal, *the* tree of the Mysore Forest Department, inasmuch as it brings in the most revenue, does not thrive in the dense forest of the Jagur Valley; but where the growth is rather open and shrubby, it abounds. That the sandal does not rejoice in dense cover, is evident from the large quantity of dead wood found in these forests. This dead wood is collected by the Department and sold annually for thousands of rupees. The quantity of such wood collected in this Range during the last official year amounted to no less than 230 tons, and the contractor has engaged to collect 200 tons more during the current year.

The teak is not uniformly represented, but occurs only in patches; and since it is the most valuable of the timber trees of the district, the Department is endeavouring by every means to encourage its growth.

The soil of the Jagur Valley is a very rich loam and the length and the girth of the boles of the trees, particularly Matti (*Terminalia tomentosa*), testify to its depth and extreme hygroscopicity. The valley comes in for a very fair share of the S.-W. monsoon; and during the rainy months (June to the end of September) the ground is very soppy.

All the State forests of this Range, and they are particularly fine, are comprised within the Jagur Valley; but I shall speak of only one of them—the Muthodi State Forest, and more particularly the south-west corner of it, where teak planting has been carried on since the year 1903.

The Muthodi State forest is nearly an island, having nallas on its north, west, south and nearly half of its east side. In extent it is nearly sixteen square miles. The Chikmugalur-Hebbe road runs more or less along the western boundary of the block,

entering it at the 6th furlong in the 21st mile and leaving it at the 7th furlong of the 27th mile. Constituting as it does a fraction of the Jagur Valley, the forest growth in the block is of a very varied kind, consisting largely of Matti (*Terminalia tomentosa*), Tani (*T. belerica*), Hunal (*T. paniculata*), Nandi (*Lagerströmia microcarpa*), Sagode (*Schleichera trijuga*), Kanagal (*Vateria indica*), Bate (*Dalbergia latifolia*), Houne (*Pterocarpus Marsupium*), Thadsal (*Grewia tiliæfolia*), Jamun (*Eugenia jambolana*), Yattaga (*Adina cordifolia*), Keechaga (*Erythrina stricta*), Dindiga (*Anogeissus latifolia*), Kakee (*Cassia fistula*), Bilwara (*Albizzia odoratissima*), and several other species of trees. The large and small bamboos abound throughout the forest. Teak is found only in patches here and there; and it is with the object of increasing the stock of this valuable species that artificial planting has been started.

The Muthodi teak plantation is, as already stated, situated in the south-west corner of the forest, and not far from the confluence of the Somavahaini and Tadave nallas, the former of which forms the western and the latter the southern boundary of the area. The Chickmugalur-Hebbe road divides the area into two nearly equal parts. The left half has a gentle slope towards the east, while the right half is nearly level. The locality is admirably adapted for the purpose for which it was taken up, and for water convenience it would be impossible to find a better spot.

It was decided by the Conservator of Forests in Mysore in his Inspection Note of the Kadur District that "a commencement be made with 50 acres on the right bank of the Somavahaini in compartment 1." The Note lays down that "the entire area should be cleared of all tree growth and bamboos, except promising specimens of Teak, Houne (*Pterocarpus Marsupium*) and Bete (*Dalbergia latifolia*), in December or January, and burnt in April, after removing all saleable timber;" and accordingly work was begun in December 1902, when the area prescribed was clear felled, except for a few Bete trees, which were left as seed bearers, and the débris burnt at the end of March 1903.

A nursery of one-quarter of an acre (10 guntas) extent was formed on the right bank of the Tadave halla. Prior to the breaking

up of the soil, a large quantity of brushwood was burnt on the spot and after the ground cooled it was dug to a depth of $1\frac{1}{2}$ feet and the clods well pulverised and mixed with the ash; beds of 2 feet width and of convenient length were then laid out, and 10 pallas of seed sown in them, the seed having first been soaked in liquid cowdung for three days. (The seed was obtained from the Lakwalli Forest.) With the object of forcing germination, since teak is so tardy in the matter, the nursery beds were covered with a layer of straw and copiously watered morning and evening.

Seedlings which attained a height of 3 inches were pricked out of the nursery beds and basketted and allowed to remain in the nursery till they attained a height of 6 inches. In this way 6,500 seedlings were treated, and they were chiefly utilised to replace casualties during the months of September and October 1903. The remaining seedlings were allowed to stand in the seed beds till they attained a height of 6 inches, when they were pricked out and transplanted into the area in $1\frac{1}{2}$ feet cube pits at distances of 8 feet apart. This work was conducted during July, August and September 1903.

During the rainy season, and until the end of January, it is well-nigh impossible to enter the forests of the Jagur Valley, and in fact any Malnaad forest, owing to the luxuriant growth of a species of Liliaceæ which comes up as soon as the rains set in and holds the field till the hot weather lays it low, only to arise, Phœnix-like, during the next year. No matter how many fires may pass through the forest during the dry months of the year, with the advent of the rains the "Sulai Soppu," for that is the name of the lily, is sure to make its appearance. In forests rigidly fire protected the luxuriance the lily affects during the rainy season is awesome. It reigns supreme, and defies the natural regeneration of the forest trees by preventing the germination of seed, and suffocating any young seedlings which may have had the hardihood to come up a few months previously. The plantation proved no exception to the rest of the forest, and so the area had to be weeded in January 1904, and again in June 1904 and again last May.

Although it is only three years since the plants were put out a good many of them are now quite 20 feet in height and 6 inches in girth; but the average height is 8 feet and the average girth 3 inches.

During the official year 1904-05 a further extent of 50 acres was operated upon; but owing to the season having been an abnormally unfavourable one, the planting proved a failure, except in an extent of about 10 acres. However, the area was replanted during June and July last, and a further extent of 50 acres added.

The appended statement gives the total expenditure incurred on the plantation of 1903-04:—

Description of work	No. or quantity.	Rate.	Amount.		
		At per	Rs	a.	p.
Felling over the jungle and burning over the débris	50 acres.	Rs. 21-8-0 acre.	1,075	8	0
Preparing a nursery 10 gunta in extent including watering charges for 35 days and other incidental charges, such as erecting a shelter, purchase of straw for seed beds, digging a drain around the nursery, transport of seed	...	...	99	4	9
Preparing bamboo pegs for aligning the area	34,000	Daily labour.	75	3	0
Weeding the area prior to aligning .	$8\frac{1}{2}$ acres.	Do.	9	11	0
Aligning and pegging off ...	Not stated.	Do.	107	4	0
Digging pits	34,000	Do.	318	9	6
Filling do	34,000	Do.	117	7	6
Planting out	34,000 plants.	Do.	122	12	6
Baskets	6,500	Rs.5-2-10 1,000	33	10	0
Filling baskets with earth and pricking out seedlings from nursery beds and basketting them	6,500	Daily labour.	19	6	6
Weeding in lines to ascertain casualties	Not stated.	Do.	49	4	9
Replacing casualties	6,500	Do.	13	11	0
First weeding, January 1904 ...	49 acres.	Rs. 3 acre.	147	0	0
First pruning, April 1904	49 do.	Daily labour.	20	3	0
Second weeding, January 1904 ...	21 do.	Rs. 3 acre.	63	0	0
Second pruning, June 1905 ...	49 do.	Daily labour.	5	0	0
Third weeding, May 1905	49 do.	Rs. 3 acre.	147	0	0
Clearing compartment lines in the area and fire lines around it ...	...	Daily labour.	41	12	0
Total expenditure ...	...	...	2,165	11	6

SYLVICULTURAL NOTES ON HARDWICKIA BINATA.

BY OLD RANGER.

Referring to Mr. E. M. Crothers' "Sylvicultural Notes on Hardwickia binata" which appeared in the July issue of the *Indian Forester*, I venture to send you a note on my observations of the Anjan (Hardwickia binata) in the Buldana Forest Division of the Berar Circle, Central Provinces.

Distribution.—Here Anjan first occurs in the extreme north of the Division, along the outer lower slopes of the Satpuras, in the Ambabarwa Range.

It again appears in the Ajanta Ghats, where it occurs in the western portions of the Ghatbori Reserve, continues throughout the Geru-Matergaon Reserve, and extends into the eastern portions of the Amdari Reserve; these three reserves forming a more or less continuous chain of forests lying along the Ajanta Ghat Hills, which run from east to west through the centre of the Division, in a direction more or less paralled to the Satpuras and separated from them by a huge, flat, gently undulating and highly cultivated plain, some 40—50 miles wide and drained through its centre by the Purna River.

In the Ghat forests the extreme eastern and western limits of distribution are very well defined, few trees being found beyond a certain ridge or ravine in either case, which coincides to a marked degree with the mooram soil tracts, an extremely hard and dry clayey soil, highly inpregnated with iron I believe.

To north and south, however, stray specimens of good growth often occur far out on the cultivated plains, which leads one to infer that possibly in ages past the Anjan forest extended right across this large intermediate plain.

Aspect appears to me to have little to do with distribution, all aspects being represented and equally favoured in the above tracts; a well-drained soil, mooram for preference, appears to be essential, and where these conditions exist trees of fine growth may often be found growing on the banks of streams.

Within the Anjan zones, wherever the soil is deep enough and contains a fair proportion of black cotton soil, with rather more

moisture than it is possible to obtain in a pure mooram soil, Anjan is found mixed with many other forest species, such as—

Khair (Acacia catechu)
Lendia (Lagerströmia parviflora)
Sadhra (Terminalia tomentosa)
Dhaura (Anogeissus latifolia)
Salai (Boswellia serrata)

and even teak, but as soon as ever we return to pure mooram soils Anjan appears growing either pure or has for an associate Salai only, presumably merely because no other species appear to be able to exist on such soils.

An enormous percentage of the stock in these Anjan forests is composed of old gnarled trees, *invariably* unsound; young pole growth is rare, and occurs in ravines principally, and undoubtedly came into existence on the stoppage of indiscriminate hacking by Forest regulations.

Sapling growth is however even still rarer, and, strange as it may read, occurs principally in the vicinity of cultivation, and the best on temporarily abandoned cultivation.

This gnarled and unsound state of the older growth is undoubtedly due to generations of lopping, whereby fungi, injurious insects, fire, etc., etc., were rendered every aid and opportunity of multiplying their injurious effects. During times of scarcity of fodder Anjan leaves are much sought after, and in former days afforded practically the only fodder supply for starving cattle; then, again, a useful fibre, yielded from the bark of young growth, *also* leads to heavy lopping.

REPRODUCTION FROM SEED.

A sporadic seeding of Anjan probably takes place every year, but regular seedlings I believe occur about every third to fifth year, when large tracts seed gregariously and generally *very* profusely.

The seed begins to fall early in May, and although heavy is, by means of the long wing with which it is provided, capable of being carried some distance by the wind, so that the whole of

the ground to leeward of a good seed bearer may be seen strewn thickly with seed.

With the first showers of the monsoon germination appears to take place, and the tap root, although the seed is lying on the surface fully exposed, manages to force its way into the hardest soils and immediately starts on its career *straight* downwards.

A week or so later the whole of the ground will be seen covered thickly with seedlings, so thickly that it is impossible to avoid trampling on hundreds on walking over the area.

My observations of the germination of Anjan seed have convinced me that very little moisture indeed is required to start germination, and so sensitive are the *very* young seedlings to excessive moisture that, if seed be sown in a pot containing leaf mould or rich soil, and this be allowed to get a little too damp, the thick fleshy cotyledons of the young seedlings are immediately attacked by rot, which extends downwards to the roots, and a whole pot of young seedlings may thus be destroyed in a single night.

The foregoing leads me to believe that the seed of the Anjan, owing to its great sensitiveness to moisture, is incapable of lying quiescent in the soil, unless that soil be *absolutely* dry, a condition which is hardly likely to continue for a twelve month in the driest of regions, outside a desert.

Therefore, unless the seed of the year had fallen just before Mr. Crothers made his fellings in February and March, I feel convinced that the supposed seedlings noticed by him after those fellings must really have existed before they were made and before the rains, that is, that they could not have been the result of the previous year's seed which had lain quiescent through one monsoon and germinated during the next one. With Anjan I find it often happens that in the case of seedlings or very young plants all growth above ground dies down or gets eaten off in the dry weather, but shoots up again on the burst of the monsoon, and these young 2—3-year-old plants are very often apt to be mistaken for seedlings of the year, until closer examination shows a thickened root stock and the scar or scars of the previous year's shoot or shoots.

Root system.—From the very first signs of germination the development of a very strong tap root becomes a noticeable feature. This tap root drills on straight downwards and apparently grows 5—6 times as fast as the young shoot above ground. I have found young seedlings, of 6—9 months' growth and only 3″—4″ high, the possessors of tap roots 22″—28″ long (actual measurements), the almost complete absence of side roots being very noticeable.

This enormous development of the tap root is maintained throughout the life of the tree, as may be seen by observing the root systems of Anjan growing on the edges of high banks or cliffs adjoining streams ; in such places, where washaways have occurred, enormous exposed tap roots may frequently be measured.

COPPICE AND POLLARD GROWTH.

In Berar Anjan does not coppice successfully ; the stools frequently produce numerous coppice shoots, but these never advance beyond a slender drooping stage, and gradually all die back.

It pollards very freely and most of the older growth is composed of pollards.

Timber.—Anjan timber is not prized in this province. It is an extremely heavy and hard wood but is only considered fit for supports, since its transverse strength is weak and it cannot therefore be used as cross beams.

The dark maroon heart wood is rarely if ever touched by insects, but the white sap wood soon gets riddled by weevils.

EXTRACTS FROM OFFICIAL PAPERS.

THE FACE VALUE PERMIT SYSTEM IN MADRAS.

Forest work in India is of such a varied nature owing to the great differences in climate, configuration and modes of life and methods of thought of the people who inhabit the great continent that the rules laid down for the working of the forests of one province are often probably entirely antagonistic to the ideas and usages of the inhabitants of another, and therefore unworkable.

Some papers* of considerable interest have been recently issued by the Madras Government on the method of working the permit system in that Presidency, together with suggested alterations to be brought into force in the future. Whilst, we understand, these alterations are suitable to Madras, many of our readers will doubtless be struck with their entire inapplicability to their own part of the world.

Considering a change in the present permit system advisable the Board referred the matter to the Conservators. The replies of these latter, together with the Board's resolution, which received the sanction of Government, are detailed below.

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* The Honorary Editor desires to express his acknowledgments to the Government of Fort St. George for copies of these Papers.

Mr. C.E. Brasier, Conservator, Central Circle, wrote as follows :—

In reply to Board's Forest Reference, No. 168, dated 3rd April 1905, *I have the honour to give below the* previous history of the introduction of the located fellings system.

In January 1895 (Board's Proceedings, Forest, No. 451, dated 29th September 1896), the Board's attention had been attracted to the existence in certain districts of what may be called the "unregulated permit system" under which applicants were permitted to go into the forests and fell a specified number of trees of certain classes wherever found. The Board then called for a report as to the tracts in which the objectionable system prevailed and for proposals for improved arrangements. The Conservator, Central Circle, reported that the system prevailed in its entirety in Cuddapah and Chingleput districts and, with certain restrictions, in the other districts (Conservator's letters printed in Board's *Proceedings, Forests, No.* 451, *dated 29th* September 1896). The Conservator, Southern Circle, reported that in no district in his circle did the system prevail, but it is evident from his reply that unrestricted fellings were and still are in force in that circle, though not of the particular kind defined in the reference.

2. At this stage Mr. Hooper, then Conservator, Northern Circle, addressed the Board on 2nd October 1895 (Board's Proceedings, Forest, No. 207, dated 12th May 1896) deprecating the injudicious introduction of the coupe system on the ground that disastrous results were likely to follow in its train as it left the contractors a free hand, and as he had reason to believe that after such clear or almost clear fellings the reproduction of important species was practically *nil* in some instances. This was referred to the other Conservators for remarks. Mr. Popert agreed with Mr. Hooper in regard to the evil effects of ill-considered coupe fellings arranged without preliminary enquiries regarding the then condition of the forests, their proposed future treatment, the effect of the scheme on the neighbouring villages as to grazing, etc. Mr. Peet also, in concurring with Mr. Hooper, remarked that the permit system, with all its faults, would create less friction, would certainly satisfy the requirements of the public far better than an

ill-designed coupe system, and might even cause less injury to the forest. He enumerated some of the defects and dangers of haphazard attempts at working under the coupe system, *viz.* (1) the yield year after year was not uniform, (2) fellings were conducted without any idea as to their probable markets, and (3) the grazing, etc., requirements of the important villages were left out of consideration. The Board thereon, in the Proceedings quoted, concurred generally in the views of the Conservators and impressed on the Collectors the necessity of instituting adequate enquiries on the several points noted by Mr. Popert, before introducing the system of located fellings into the districts.

3. After thus disposing of this matter the Board took up the original subject for consideration, and observed in its Proceedings, Forest, No. 451, dated 29th September 1896, that the "unregulated permit system" was prevalent only to a small extent, and was gradually being replaced by more satisfactory arrangements, which would be improved and systematised as experience was gained. The Government thereon in its Order, Mis. No. 4447, Revenue, dated 10th November 1896, printed in Board's Proceedings, Forest, No. 521, dated 18th November 1896, laid down that efforts should be made to get rid of the permit system wherever it still prevailed.

4. From the latest annual reports from districts it is observed that the permit system and unregulated fellings do not exist in North Arcot, South Arcot, Tanjore, North Salem, and South Salem. In Cuddapah, with the exception of thirteen coupes which were under systematic working, the rest were worked under the permit system. In Nellore, except in areas dealt with in the Sriharikota and Casuarina plantations and certain minor working plans, the permit system was in force in the remaining areas. In Chingleput and Trichinopoly the permit system was in force almost throughout the districts. Generally wherever there are working plans framed, there are located fellings: in other places the permit system prevails.

5. As regards grass, permits were issued for its removal in Cuddapah, South Salem, and Trichinopoly. In other districts there was no demand or the grass was leased out.

6. It will be observed from the above that the Conservators in 1895, while approving of the well-considered plans for located fellings, deprecated haphazard measures in this direction. I fear however from the general forewarning tone of the Conservators' letters then issued that some District Forest Officers were only too glad of the excuse for doing nothing in this direction, and hence we find that in some districts of this circle, *viz.*, North Arcot, North and South Salem, South Arcot, and Tanjore, a great advance has been made by the abolishment of the permit system as previously understood; in other districts, *viz.*, Nellore, Cuddapah, Chingleput and Trichinopoly, little has been done in this direction. I am of opinion that located fellings can be introduced in all districts if proper measures are taken by the District Forest Officers towards this end. They will have to be combined with depots in towns in some localities, while in others contractors may be found to work the coupes, or, again, in other places a modified form of permit system, as the Government evidently foresees, will have to be introduced by placing the permit-issuing gumastahs in the forest to issue permits and supervise fellings. The latter is indeed usually the first step necessary where contractors cannot be got. Personally I am of opinion that the Government has taken very beneficial action in requiring that the measures to be taken towards further extending the system be reported, and it now rests with the District Forest Officers of the districts in which the system is not given yet widespread effect to introduce it without further delay, reporting to the Conservator the action they intend taking in order that he may give them advice and see that the possibility of the forest is not encroached upon. I would therefore advise that Collectors be requested to see that their District Forest Officers take action towards this end at the earliest possible date.

The following are Mr. A. W. Lushington, Conservator, Northern Circle's, remarks:—

With reference to Board's Proceedings, Forest Reference No. 168, dated 3rd April 1905, I have the honour to inform you that I quite agree that the permit system is most obnoxious; that it

has but little to recommend it financially or politically, and has everything against it sylviculturally.

2. I notice in their Order No. 681, dated 17th April 1871—34 years ago—the Government remarks—

"The objectionable license and voucher system is still in force in the whole range of country with which the Forest Department have any concern. The Government desire that it shall be the constant effort of the Conservator and his deputies to extend the depot and periodical auction system as much as possible, and to put a speedy end to the license and voucher system, which is fraught with facilities for fraud and oppression."

3. I am of opinion that this sums up the case most clearly, and have pointed out more than once how the words of Government in the ultimate sentence are being fulfilled. Of course until the Act was passed and settlement completed it was difficult to put a stop to the system

4. I am at present in communication with the Collectors of the different districts to see how and to what extent the abolition of the permit system can be effected : and I am glad to be able to inform the Board that in West Kurnool a great stride has been taken to this end, Mr. Wood having made an excellent commencement of departmental fuel and bamboo felling combined with the stopping of permits. I have requested the Collector to let the Board know what is being done in this respect.

5. In some districts there is still a desire to retain the permit system ; but I regret to report that it is chiefly in those districts where protection is at its worst. In some districts the officers are anxious to put a stop to it, but they seem to fear that the necessary establishment to carry out located fellings would not be sanctioned ; and in a very large number of instances they express the opinion that the existing type of range officer would never carry out the alteration satisfactorily. There is not the slightest doubt but that to have it properly effected we must have a better class of man than we have at present, and this is a point that is now under consideration between the various Collectors and myself with a view to addressing the Board on the

subject. The majority of range officers, or, at all events, of the inferior type of range officers, are, for obvious reasons, against the change, and one question is whether we shall not have to clean out the Augean stable.

6. The alteration to be effective must be undertaken on a large scale; the expenditure will of course be great, but the gain financially and sylviculturally will be enormous. The question is whether a very large outlay would be sanctioned. If this is answered in the affirmative, I will address the Collectors with a view to having the whole scheme everywhere put on a proper basis.

Mr. Gass wrote—

I have the honour to inform you that the value of the recommendation made by Government is fully recognised, and efforts are being made to restrict removals to selected localities in the limited number of places in this circle in which permits are being issued. The opening of depots for the sale of wood for domestic purposes and agricultural implements is being gradually extended, and as the supplies to these depots are made departmentally the necessity for the issue of permits is largely reduced.

Where the employment of permit-issuing officers is still required the necessity for locating them in or near the forests is being urged.

Board's Resolution—Forest, No. 161, *dated* 1*st August* 1905.

Everybody is aware of the objections to the unregulated permit system and of the desirability of introducing departmental fellings and depots. But the change is not altogether an easy one, and is not to be carried out by a mere stroke of the pen. It would be easy to stop the permit system, but the introduction of departmental fellings implies working plans and men to carry them out. The Board recognises these difficulties and is prepared to make allowance for them.

2. At the same time, it is very desirable that the change should be made: Conservators and Collectors are evidently aware of the fact, and considerable progress has already been made by many District Forest Officers; but the Board would impress on all

officers the need for still greater effort; a careful study of the needs and possibilities of their district is a necessary preliminary, but action should be taken as soon after as possible to supply those needs by suitable departmental arrangements, or by the nearest approach thereto, which the district organisation is capable of, *e.g.*, by the contract system, which obtains in Tinnevelly, or by the restricted permit system over limited areas, with gumasthas on the spot, to which Government refer, or by any other arrangement which District Forest Officers may consider suitable. Anything is better than the plain unvarnished "permit system" of old days.

3. The Board does not wish to suggest hasty and ill-considered action that will only result in failure—failure to benefit the forests, or failure to supply the public—but the Board would nevertheless request Collectors and Conservators to take the matter in hand at once, and consider what can be done; if more men are wanted on the temporary scale, the Board is ready to supply them.

4. Collectors will be requested to report in due course, through the Conservators, what advance they can make in their districts; and the Board will then submit a consolidated report on the matter to Government, in accordance with paragraph 2 of Government Order, No. 273, Revenue (Forest No. 59), dated 22nd March 1905).

MISCELLANEA.

KINO FROM CROTON TIGLIUM.

BY DAVID HOOPER, F. I. C., F. L. S.

A sample of "Gum of *Croton tiglium*" was presented to the Indian Museum in July last by the District Forest Officer, South Salem, Madras Presidency. The specimen was highly coloured for ordinary gum, and after examination was found to be an astringent secretion or kino. It was in brittle fragments of a black colour, with garnet-like edges, the taste was styptic, and it dissolved in water and rectified spirit with an acid reaction.

It had the following composition :—

Water	17·2
Tannin	65·0
Soluble non-tannins	6·8
Insoluble fibre	0·5
Ash...	10·5
	100·0

The aqueous solution gave the same reactions with ferric and ferrous salts, plumbic acetate, and mineral acids as Malabar kino. The amount of ash is rather large for kino, and is accounted for to some extent by the presence of earthy matter or sand.

The District Forest Officer, on being written to for further information on the yield of gum, and for a larger sample, replied that the small quantity (weighing about one ounce) had been collected at the base of about thirty trees, where it appeared to have exuded naturally. The tree known as *Croton tiglium*, Linn., is the "Katta-Kottai" of the Tamil people, and the seeds are the source of the croton oil of commerce. According to Sir Joseph Hooker's "Flora of British India" there are twenty seven indigenous species of croton, and a number of introduced species are grown for ornamental purposes, but, as far as can be ascertained, it does not

appear that a kino-like exudation from these plants has previously been recorded in India.

Writers on the subject of "Dragon's blood" have referred to species of croton as yielding a variety of this drug. In Central and South America there are at least four species yielding kino-like secretions known as "Dragons's blood," or "Sangre de drago." These have been identified as (1) *Croton draco,* Schldl., in Mexico and the Central American Republics; (2) *Croton erythræum,* Mart., in Brazil. The gum is known as "Pao de sangue de dragao," or Brazilian kino, and it is used externally and internally as a styptic.; (3) *Croton hibiscifolium,* H.B.K.; and (4) *Croton polycarpum,* Benth., in Columbia (in the neighbourhood of Papayan), yield similar juices to that of the first named.

In L'Ecole de Pharmacie, Paris, there is a sample labelled by Prof. G. Planchon: "Croton Draco. Sangre de drago des Mexicains; c'est le kino des indigenes par l'usage identique recolté sur l'arbre qui croit abondant dans l'Etat de Vera Cruz; envoyé en 1854 par Schaffner en Mexique."

Prof. Ed. Schaer, of Strasburg, to whom I am indebted for information on the American crotons, published a list of kino-producing trees in *Berichten Deutsch. Pharm. Gesellschaft* (May 14th, 1901). One more species may now be added to his list.—*Pharmaceutical Journal*, October, 7th, 1905, p. 479.